

COST-KEEPING FOR  
MANUFACTURING PLANTS

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STERLING H. BUNNELL

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FOR  
**MANUFACTURING PLANTS**



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# COST-KEEPING

FOR

## MANUFACTURING PLANTS

BY

STERLING H. BUNNELL, Ph.B., M.E.

MEMBER OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

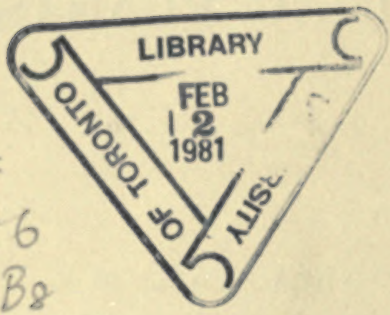
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## P R E F A C E

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CORRECT cost-keeping is of vital importance to every manufacturing enterprise.

To the experienced accountant, the author hopes to present, in an orderly, concise, and comprehensive manner, approved principles of correct cost-keeping.

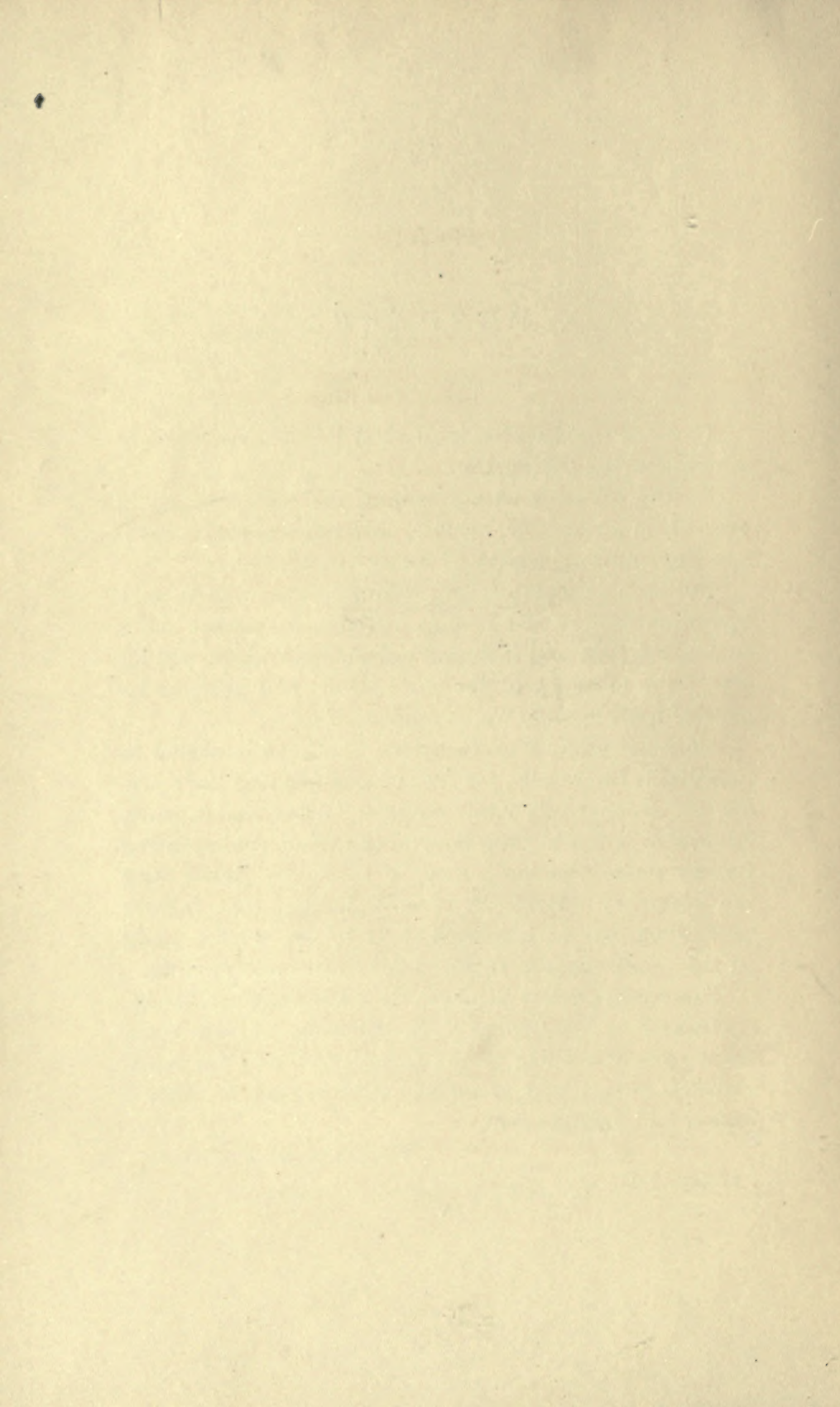
To those accountants and manufacturers who have in operation modern cost-keeping methods, the author hopes to suggest time and labor-saving methods which will increase the accuracy of the cost-system, and promote its general usefulness to the organization.

To those other manufacturers who have hesitated to investigate their costs, for fear of encumbering their productive effectiveness with "red tape," delay, and expense, the author hopes to show how labor-saving, cost-reducing factory superintendence may be so closely linked with the necessary operations of cost finding, that factory production may be increased so as to pay a huge profit on the small expense required for systematic records.

The author takes pleasure in acknowledging his indebtedness to Mr. George V. S. Michaelis, of New York, for a careful reading of the manuscript, and for much valuable advice and assistance with regard to subject matter and arrangement.

STERLING H. BUNNELL.

MARCH, 1911.



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# COST-KEEPING

## FOR MANUFACTURING PLANTS

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### CHAPTER I

#### INTRODUCTION

INFINITE pains in improving a manufacturing process or its product are without valuable result unless the operation runs at a profit. Cost and selling price are the ruling factors, which makes it evident that accounting is quite as important as production, and may well be developed and amplified into a system of controlling standards by which the success of every detail of the manufacturing operation shall be measured.

“Manufacturing” implies a complete, well-regulated process, carried on by men of divers capacities and training, and directed by a capable head. To construct a device may be the year’s task of one man. To manufacture it may be a few minutes’ work for a factory force. As simplicity is the feature of the first, so complication is the essence of the second. If the scope of the work is small, the managing head of the factory may carry the whole complex detail in his own knowledge. Otherwise, he will be content to guide the several efforts of specialists, each responsible to him for results. The control may rest in a board, or a committee, instead of in one

## COST-KEEPING FOR MANUFACTURING PLANTS

man. But whatever may be the exact form of the direction, the whole complicated organization of men and machines has but one primary purpose, which is financial success. Order, differentiated skill, and concerted effort develop, from the inherent complexity, the superior efficiency of the complete manufacturing organization.

The requirements of a correct system of ascertaining costs, even in an organization of only moderate size, place a heavy responsibility upon the accounting head. His books must deal with items of plant equipment amounting perhaps to hundreds of thousands of dollars, and at the other end of the scale, items of material and labor involving a few cents each, but numbering hundreds per day. The large items are of interest to the management only, and are recorded in journal and ledger, in accordance with standard accounting principles. The small items, particularly those relating to purchases, material used in factory work, and labor, being intimately connected with the manufacturing operations, must be recorded in the factory, and without interfering with manufacturing routine. The general accounts are kept in the main office in direct charge of the accountant. The factory cost accounts are delegated to shop-trained clerks under the accountant's supervision.

To illustrate the relation between accounting and cost-keeping, the general accounts may be said to illuminate the whole field of the business, while the cost-records send a powerful ray in one direction, bringing out the details of the factory operations, in which profits and



## INTRODUCTION

losses have their source. The accountant employs a broad knowledge and trained judgment in setting forth the daily progress of the business toward success or failure. The cost-clerk, working in his narrow range, produces a systematic record of the cost of each particular unit or "job" of factory work, with the contingent relation of each to the general expense of maintaining the factory organization. The accountant charges his cost-clerk with the outlay for running the plant; the cost-clerk reports back to the accountant the individual and total costs of the subdivisions of the factory work produced as the result of the outlay.

The responsible head, whether treasurer, auditor, or bookkeeper, exercises general control over the manufacturing accounts of material, wages, and expense, but cannot burden himself with all their details. The cost-clerk understands the technicalities of his own work, but is not in a position to develop proper methods and coordinate them with the general accounts. The works manager, who is vitally interested in the work of both, has his own problems of administration to solve, and little time left for the study of accounting systems; and yet all the resources of accountant, cost-keeper, and manager are needed in developing that cost-system which shall best supply their several needs.

Simplicity, convenience, and time-saving are the three essentials of cost-keeping efficiency. Accordingly, the methods and forms given in this book have been selected, condensed, and improved, after repeated trials in

## INTRODUCTION

practical use, so as to save clerical work, while giving complete, detailed cost-records. The accountant is in general control, so that his requirements should be first provided for. He names the general accounts, directing his cost-clerk as to the divisions into which the charges must be grouped, and the time and manner of forming the charges into statements, summaries, and totals, so as to set forth the real condition and progress of the business. The cost-clerk's needs are in the direction of quick and accurate methods of balancing, totaling, and keeping track of items, so that his records may be kept smoothly and without confusion. The works manager needs results principally, but must be able to refer to the preliminary steps whenever generalities are insufficient.

The principles of accounting are established and unalterable. Cost-records must follow the rules of the general accounts, coördinating with them at every point, and supplementing them by showing the details from which the general totals are built up. Some of the systems in use, however, while correct in principle, leave much to be desired in the way of simplicity, convenience, and economy of time. The methods herein described are correct, and at the same time free from complication. They are applicable to existing operations as well as to new factories. To satisfy himself on these points, any interested accountant, treasurer, or manager has only to apply the test of actual use.

## CHAPTER II

### GENERAL PRINCIPLES OF COST-ACCOUNTING

THE feature of modern industrial organizations is the division of work among various individuals, each skilled in a particular operation or trade, in contrast to the completion of the whole construction by a single worker. All degrees of this process of subdivision may be observed in the business world of to-day. The local cobbler, for instance, operating his own shop and performing for cash on delivery the small jobs that are brought to him by chance passers-by, pays nothing for book-keeping or collection, or for advertising, and enjoys the minimum of so-called "indirect expense." If his business expands, by reason of a well-selected location, or the acquisition of friends among satisfied customers, his duties become more complicated, and the burden of them weighs heavier. He finds it necessary to hire other workers, introduces some form of accounts to accommodate customers who desire credit, and accumulates and carries on hand a stock of materials to permit the completion of work promptly and cheaply. He undertakes the manufacture and sale of shoes and articles pertaining to them. He begins to suffer some of the losses, such as depreciation of stock and bad debts, which are unavoid-

## COST-KEEPING FOR MANUFACTURING PLANTS

able contingencies of complex industrial organizations. In the course of time, he will be enabled to throw off the duties foreign to his trade and difficult or repugnant to him, by hiring men skilled in these special matters, and so there may be built up by degrees an organization including salesmen, bookkeepers, foremen, journeymen, laborers, and all the rest.

In the conducting of industrial business there are three principal divisions or functions—namely, selling, production, and administration. The sales department of an organization may originate in a time of bad trade, when the inflow of unsolicited orders ceases to keep the works fully occupied. Salesmen employed during such a period become familiar with the opportunities for the sale of the output, and, being retained into periods of sufficiency and even oversupply of work, devote their efforts to making sales at greater profits and spreading knowledge of the product among possible later customers. The business-getting organization is indispensable for the successful operation of any large manufacturing enterprise. Its work comprises the spreading of information, by advertisements in periodicals and otherwise, by letters, circulars, and catalogues mailed to possible customers, and by careful canvassing of all fields wherein prospective purchasers may be found; the following of inquiries, by correspondence, personal visits and special favors, and the quoting of prices; and finally the drawing of bills of sale and contracts which clearly define the materials and work to be furnished

## GENERAL PRINCIPLES OF COST-ACCOUNTING

by the seller, the investigation of credits, and the delivery to the works of the necessary complete information in the form of sales orders or written contracts.

2 The production department, which comprised the whole of the primitive establishment of one worker, becomes in modern industrial works a constituent part of the managing force. Its work commences where that of the sales department stops. The production department provides materials and working force, and directs the factory work by general orders, subproduction orders, and so on down to instructions to the individual workmen. Divisions of the work of this department are the designing, the making of necessary drawings and schedules; the purchasing of materials and supplies; and the planning and supervision of the work of production, to meet the requirements as to cost, and to satisfy the conditions of delivery.

3 The administration is over the sales and construction departments, and in touch equally with each. The ruling heads, in a corporation, are the officers; in a firm, the active partners; sometimes, a single person, the general manager. The duties of the department comprise the provision of the necessary funds to carry on the business, through attention to terms of payment, deliveries of goods, and collections, so that income shall keep pace with expenditure. This department has entire charge of the general accounts, and through the treasurer or other accounting head, of the cost-keeping system. Other du-

## COST-KEEPING FOR MANUFACTURING PLANTS

ties of the administration comprise the supervision of sales, with regard to the general character of the work to be done, prices and terms and credit of customers; and of expenditures, with regard to the quantities of stock to be carried on hand, the maximum rates of wages to be paid for the various kinds of help, the advisability of purchasing new equipment or undertaking expensive repairs which could be postponed, and similar questions of general policy. If the administrative functions are intrusted to a general manager, his work must consist of a comprehensive oversight of all departments, rather than minute and time-consuming personal investigation of the myriad of details.

The accounting system of the factory must be so organized and operated as to furnish all necessary information promptly and automatically to each of the three departments. Most of the information required by salesmen, factory heads, and works manager comes through the cost-keeping branch of the accounting department, the important figures of the general books being of a private nature, for use by the executive authority only. The sales department needs to know the cost of work which has been done, in detailed statements which can be used for the purpose of estimating the cost of similar work which must be quoted upon. The construction department requires the material and labor cost of each job for comparing with the cost of current work, determining the improvement or deterioration of the superintendence, and ascertaining the costs of parts required

## GENERAL PRINCIPLES OF COST-ACCOUNTING

for repairs or made up ahead for stock. The administration demands monthly and annual reports covering the expenditures for the various classes of work done, summarized in such a way that the general progress of the work may be constantly observed, and the existence noted of every increase or decrease in cost of work, or in ratio of expense to value of factory product, or in value of work in progress at a given time, or of product completed in a given period.

In the hypothetical one-man shop, the proprietor could ascertain his financial standing by feeling in his pocket. Counting his change, however, could tell him nothing as to the profit on individual jobs. In an organization paying regular wages to many workers, and carrying a stock of material, purchases and pay roll must be provided for in different units and at different times from those governing the payments for product or services sold. Prices for factory product can be safely made only with exact knowledge of costs; or else costs must be limited to amounts fixed by market prices, which requires the same exact information. Accordingly, books and records should be kept so as to set forth, not only the state of the business, but also the exact relation of the cost of each item of factory product to the price received for it. The first is the office of the general accounts; the second, of the specialized branch known as cost-keeping.

The books of general account are kept by standard double-entry methods, and require the supervision of an

## COST-KEEPING FOR MANUFACTURING PLANTS

accountant of capacity and training suitable to the magnitude and degree of complication of the business. The science of accounting covers a field much too broad to allow of more than a brief citation of its principles as far as they may serve to assist the cost-keeper.

The factory exists by reason of the constructive work of those who erected its buildings and provided its equipment; for which work they were paid by some one possessing the necessary funds. The equipment of the factory, from land to small tools, therefore represents value or property, otherwise Capital. The ownership of the factory may be in one man, or divided in any way whatever among several holders of shares. Usually, the total number of shares is given a nominal value in dollars, and each unit share then has a face value, preferably \$100. The shares, however, represent nothing definite except the proportion which each bears to the whole. It may be possible to sell a share for its face value, or twice its face, or only a small fraction of the amount, according to the demand—the market; so that obviously, the temporary value of the whole capital stock may be its face, or any other sum. The principal condition determining quoted stock value is the amount the corporation can earn, and therefore pay for its use of the capital which the shareholders supplied when they (or their predecessors) paid over their money for their interest. The management of the works is under obligation to pay the stockholders for the use of their money,



## GENERAL PRINCIPLES OF COST-ACCOUNTING

through dividends which the works must earn for the purpose.

Since the market value of the capital stock depends on earning power and prospects, it is evident that its direct connection with the value of the equipment must have ceased to exist. The original outlay may have included, besides the fixed plant, the values of patents, franchises, good will, or any other intangible rights. The land may increase in value, but the machinery must gradually wear out and become out of date. All these matters have only an indirect effect on the value of the capital stock as indicated by the market price of the shares. But, if the equipment deteriorates to such an extent as to impair earning power, the works will not only cease to pay dividends, but will operate at a loss and eventually become bankrupt, and the capital share value will vanish. Hence, the equipment must perpetuate itself by repairs, betterments, and renewals, so that its working efficiency may not decrease; and while it is gradually passing from excellence toward age and uselessness, a fund must be set aside to provide means for the inevitable day when machines must be scrapped and replaced. This is done by an allowance for "depreciation," which is charged as one of the expenses of the works. The value of the plant is thus maintained in spite of the lapse of time.

The entries in the journal of a new corporation taking over an existing works would show the actual or inventory value of "Plant," set forth in convenient sub-

## COST-KEEPING FOR MANUFACTURING PLANTS

divisions, as real estate, buildings, foundry, machinery, etc., on the debit side of the accounts, and against these, a credit to capital stock at its full or authorized value. It will generally be the case that this authorized value will be a round sum, greater than the inventory value of tangible property; therefore, since the journal must balance, the amount representing the rest of the earning power is introduced under some such name as "Good Will" or "Franchise." Another way is to assign an arbitrary value to the plant, or equipment, or drawings, sufficient to balance with the capital stock. It is clear that there is nothing improper in introducing such values, though not represented by tangible property, since the authorized amount of capital stock is purely arbitrary, being fixed by the incorporators in accordance with the probable net earning capacity of the works. It is usual to provide for issuing stock in such an amount that the probable dividend will be at the rate of six per cent or more, as may seem most likely to create a market for the stock at or above its face or "par" value.

If the corporation when organized must build its plant from the ground up, the opening journal entry would differ only in the substitution of "Cash" for the "Plant" entries. If the stock were sold below par, or given in part as a bonus, or in payment for some valuable right, the balance on the debit side would be made up by the entry of a nominal account as before. When construction commenced, the outlay would be debited to the

## GENERAL PRINCIPLES OF COST-ACCOUNTING

proper Plant accounts and credited to Cash, so that in the end the plant would appear on the books at cost. The value of plant and rights ought to be maintained or increased by making repairs and betterments as required. If the management follows this rule, a fixed and invariable portion of the capital engaged in the works will be represented permanently by the manufacturing plant.

To operate the factory, it is necessary to provide a stock of materials and supplies, to pay wages at regular intervals, and to complete the product and place it in the purchasers' hands months before payments are received. Materials are purchased on credit, and the invoices become "Accounts Payable" until payment is due. Sales on credit give rise to "Accounts Receivable." Wages, however, must be paid promptly in cash. It takes time to carry out the manufacturing processes and convert raw materials into finished product, so that accounts for purchases fall due before payments are received for the finished goods. Funds must therefore be provided to pay for the materials and labor represented in the stock room, in uncompleted work, and in finished work in stock or sold on credit. The value of these large items fluctuates with the state of trade and with circumstances, and the amount of capital so invested is accordingly variable. Recognizing the difference between the comparative certainty of the value of plant and equipment, and the fluctuation of the value of materials and work in progress, many corporations pro-

## COST-KEEPING FOR MANUFACTURING PLANTS

vide for the latter by a separate fund known as "Working Capital."

In very large works, the value of the plant may be partly covered by bonds, or by preferred stock, secured in case of dissolution of the business by the salable nature of the fixed property; while the more fluctuating values of stock and work in progress, and the franchises, rights, or fictitious accounts representing not property, but earning power, are represented by common stock, which will have little or no value in case of closing out the business. Accordingly, the usual arrangement for financing an enterprise provides that holders of bonds receive a fixed and small rate of interest, and have the maximum of security for their principal; preferred stock receives more, and may be less secure as to principal; and the common stock gets all there is left of the earnings, sometimes running into hundreds per cent; but takes its chance of disappearing if the plant is closed out for the benefit of bonds and preferred, so that earning power ceases and "rights" lose their value.

The Statement (Fig. 1) represents the value of the property of an imaginary United States Manufacturing Company at a given date. The single account "Plant" represents the fixed value. A considerable portion of "Accounts Receivable" is as good as cash, and will be collected in full even in case of winding up the affairs of the corporation; so that also represents permanent value, as does "Cash." The next two accounts are less certain. "Material" may include

## GENERAL PRINCIPLES OF COST-ACCOUNTING

U. S. MANUFACTURING CO. STATEMENT, FEBRUARY, 28, 1910.		
	<i>Dr.</i>	<i>Cr.</i>
Cash .....	\$6,701.11	
Plant .....	57,251.23	
Accounts Receivable .....	25,369.83	
Material .....	32,348.75	
Work in Progress .....	15,819.61	
Product .....	33,300.65	\$53,788.23
Accounts Payable .....		17,002.95
Capital Stock .....		100,000.00
Total .....	\$170,791.18	\$170,791.18

Compare with p. 270

FIG. 1.

some old, damaged, or unsalable goods, and at best will hardly bring face value at a forced sale. "Work in Progress" is the value of material and labor represented in unfinished factory product. Some of the goods may be damaged in manufacture, or of excessive cost through some fault, or of designs which have suddenly become obsolete, as by a change in fashions. These, with the uncertain portion of "Accounts Receivable," are some of the values which, in a larger corporation, would be properly carried by a special issue of "Working Capital."

On the credit side of the journal, "Accounts Payable" represents purchases for which bills are not yet due. "Product" appears on both sides. The value in the credit column is the total invoiced value of manufactured goods sold to date. The debit amount is the total cost of the goods. The difference would seem to be the profit made

## COST-KEEPING FOR MANUFACTURING PLANTS

in the operation of the works; but this will be reduced by contingencies such as cash discounts, bad debts, and "reclamation." The sole remaining item is capital stock, the amount of the entire outstanding issue of the corporation, and it balances the sheet as it should.

The absence of individual accounts from the statement suggests the use of the voucher system. A copy of each invoice for goods sold has been filed in a loose-leaf holder to form a sales book, and the total of these invoices is the amount credited to "Product." The amounts are posted to the debit of the individual purchaser's accounts, and the aggregate not paid is the total of accounts receivable. On the credit side, accounts payable has been made up as follows: Each expenditure is recorded by a consecutively numbered voucher (Fig. 2), consisting of a folded sheet of paper about seven by eight and one half inches, the folded voucher measuring three and one half by eight and one half inches. Inside of the voucher is attached the paper, memorandum, or invoice describing the transaction; or the items may be entered directly on the voucher. The form shown by Fig. 2 is printed on one page to serve as a bank check, and when filled out and signed is mailed to the creditor and paid through his bank, thus serving as a receipt in full for the amount of the charge represented. The amounts of the vouchers are entered in the Voucher Record (Fig. 3), to the appropriate accounts, and credited to "Accounts Payable." When payments are made, the aggregate amount of the vouchers paid is charged to "Accounts

Voucher \_\_\_\_\_

ENDORSEMENTS

Pay <u>Fifty \$</u>		New York <u>Jan 1, 1910</u>
To the order of <u>Hebalds Johnson Co.</u>		Dollars <u>\$50<sup>00</sup></u>
<small>IN FULL PAYMENT OF ACCOUNT ON VOUCHER NO. 1. DO NOT WRITE AGAINST RECEIPT. IF RECEIVED? PLEASE RETURN.</small>		
Ent. <u>M.S.A.</u>	U. S. MANUFACTURING CO., N. Y.	
Chk. <u>1441</u>	<u>J. J. Johnson</u>	
O. R. <u>Rec</u>	President	

FIG. 2.—VOUCHER.





## GENERAL PRINCIPLES OF COST-ACCOUNTING

Payable" and credit is made to "Cash." This method does away with individual ledger accounts for purchases.

The statement (Fig. 1) is as the accountant would take it from his books at the close of business on the afternoon of the statement day. The next morning the process of issuing material from stock room to work in progress commences as usual. There may be a thousand such items in a single day, each implying a charge to "Work in Progress" and a credit to "Material." At the same time, the force of workers will be accumulating wages due, and thus transferring the value of their time from the Company's credit also to "Work in Progress." Evidently the general journal is no place for this myriad of small transactions; and yet the aggregate must be made known and transferred on the books before the next statement day, so that the condition of the work may be correctly set forth.

The accountant employs the cost-keeper at this point, to form the necessary accounting link between the factory force and the main office. The cost-keeper opens and carries on a separate account with each factory order or "job," so that its individual value may be recorded. At the end of each accounting period he foots up his sheets, balances their totals against the total values of material issued from stock and labor paid for through the pay roll, and, finding that they agree, reports to the accountant the totals to be transferred from "Material" to "Work in Progress," and from "Work in Progress" to "Product."

VOUCHER RECORD

MONTH OF Jan. 1910

DATE	VOUCHER No.	NAME	DATE Bill	AMOUNT	BLDG.	EQUIP'T	MAT'L	LABOR	Supp's	ANNUAL	SELLING	ACCTS. B.	Gen. Lias	Treasurer
1 Jan 1	1441	Chas. Johnson Co.	Dec 22	46.00			46.00							
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154 inches wide; the full page has 50 lines

FIG. 3.—VOUCHER RECORD.

## GENERAL PRINCIPLES OF COST-ACCOUNTING

The work required of the cost-keeper depends upon the nature of the factory product. An hour per day may suffice for all entries in a shop making a homogeneous product under regular working conditions; while a large works building special machinery may employ a force of a dozen clerks, and keep an accurate record of the cost of each separate part of each machine. In any case, simplicity, convenience, and time-saving methods are absolutely essential. The records will accumulate in large quantities as time passes, and if they are not cheap, simple in use, and adapted to filing for easy reference, the cost-system will be excessively expensive and grossly inaccurate, and will soon fall into hopeless confusion.

In the forms shown, simplicity and convenience are features. There are but three sizes: the three-inch-by-five-inch card, the five-by-eight card or sheet of paper, and the eight-and-one-half-by-eleven sheet of paper, which is the regular size for letter heads. All these can be cut economically from stock sizes of paper and filed in standard drawers, trays, and binders. The largest sheet is convenient in use even when two or three books must be worked side by side. The size of the paper may seem a matter of small importance; but it is worth much thought to develop convenient forms, suited to standard holders, and as small as possible, to avoid the fatigue and loss of time caused by working on abnormally large books. The ruling of the forms gives just enough room for the figures, and wherever typewriting is required, agrees with standard line spacing, so that the sheet once

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inserted in the typewriter may be quickly and neatly filled out.

As many of the forms are for transmitting information from one department to another, it is important to insure against loss or misdirection of papers. Each form is accordingly printed on colored paper, the color indicating the destination of the sheet. All factory orders are on buff or plain manila paper; material tickets and all cost-department copies of forms used in the shop are blue; shipping papers are yellow, and general office forms, including cost-sheets, are white.

The fact that there are many copies of the forms going through the works all the time makes it practically certain that papers which may slip from their places will be noticed and put with others of their kind, so as not to be lost. The name, method of filling in each space, and the destination of the sheet are indicated on each form. This greatly assists in establishing the routine and maintaining it without disturbance, even in rush periods, and in spite of the usual changes in the clerical force caused by promotions or resignations.

The cost-keeping system, in brief, requires the recording of each item of material or labor on a separate memorandum ticket, for which the three-by-five-inch size is adopted. Accordingly, each piece of work (in shop language, "job"), such as the drilling of ten holes in each of a single lot of twenty-five pieces of steel, is noted on an individual job ticket, showing the number or name of worker, hours worked, rate of wages, and amount due

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the worker. Each lot of material issued from the stock room is entered on a material ticket, giving quantity, rate, and total value. The labor tickets for a single day, arranged consecutively by the numbers of the employees, afford a ready means of making up the day's pay roll and of comparing the total time claimed by each employee with the time registered by the time-keeper or time-clock, thus making sure that all time paid for is properly charged on the cost-sheets. Similarly, the material tickets for one day when totaled show the value of material issued from stock rooms and put into work in progress. If these labor and material cards are sorted by order numbers, totals of the labor cost of the several orders, and of the value of material used on each, may be obtained.

By filing away each day's cards for material and labor with other cards bearing the same order numbers, at the completion of any works order, all questions relative to the dates on which work was commenced and finished, the identity of the men who did the work, the time of day at which the work was done, the number of men employed on any one day, and a multitude of similar questions can be answered by inspection of the cards; and the material record is similarly explicit. Analysis of the cost of the order is thus readily made, whether for the purpose of satisfying a complaining customer of a job shop, or showing the works manager possible reasons for the increase or decrease of cost of work in comparison with previous jobs, or giving the sales department

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an idea of the probable cost of machinery or other product similar to but not identical with work previously done. Further, with this system of cost-keeping the equality of the material issued and hours of labor paid for, with the material used in work and the hours of labor charged to orders, is assured; for the tickets are vouchers for the items of material and labor, and the identical vouchers are assembled and totaled to ascertain the costs of the orders.

The system thus provides records of every desirable item of information. Its practical usefulness depends entirely upon proper indexing, and upon the arrangements for summarizing the items into convenient groups. With poor indexing and classification, a mass of cards soon accumulates and buries all the information so deep that nobody can possibly get at it. With records kept in order, it is easy to obtain any special figures which may be required, and to take off reports of summaries to show the condition of the factory work. Too much undigested detail is a serious fault with any cost-system, for inaccessibility of the record renders the record useless. Successful manufacturing depends very greatly upon full knowledge by the executive department of the cost and condition of the factory work. The use of methods requiring days of extra work outside regular hours, to dig reports out of an unclassified mass of figures, is a serious handicap to the management.

## CHAPTER III

### ELEMENTS OF COST OF MANUFACTURED PRODUCT

FROM the business point of view, the manufacturing plant is operated for the sole purpose of producing goods for delivery or sale. All expenditures are made for this one purpose. All receipts from the manufacturing operation are ultimately derived from the product shipped. It would therefore appear that the cost of the whole product is the amount of the whole expenditure, and that cost-finding is a simple problem in division.

Applying this conception hypothetically to the first manufactured product in sight, say the paper on which these words are printed, the incompleteness of the deduction is at once seen to amount almost to total fallacy. The quantity of paper turned out by the mill will probably vary from day to day, and the daily payments upon accounts will be yet more variable. If we make the period longer, say a month or a year, and average output and expenditure, how shall we know whether the machines and men did not make less paper in the last half of the period, while the rate of expenditure was unchanged? If the apparent cost of paper is increasing, due to heavier cost of upkeep, shall we decide that the new superintendent is incompetent, or that the former incumbent

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reduced expenditures by omitting to make necessary repairs? If the mill accountant can answer these questions to his satisfaction, there are yet many others. How much idle land is there on which the mill is paying taxes while deriving no benefit at present? The equipment will wear out in a few years, and must be replaced; the gradual loss in value as the machines progress toward the scrap pile is part of the true cost of the paper they are now making, but how much is it per pound of product? Suppose the mill makes alternately two kinds of paper on the same machine at different speeds; how shall we get at the difference in cost? All these and other questions must be answered in the operation of any system of accurate cost-keeping. The sheet of paper consists evidently of material, increased in value by labor; but the labor was done on the material by virtue of an expenditure which is not visible in the finished product, and yet forms a large fraction of its cost.

To determine the real cost of a manufactured article requires the carrying out of a continuous process of cost-accounting over a term of months or years. The only substitute for the time element is careful estimating of probable expenditures, based on known results of such cost-recording in other factories with like equipment and similar product. Material is easily weighed, measured, or counted, and its market value computed for each lot of manufactured product. Factory expense, including the labor of "helpers," sweepers, watchmen, and others not directly engaged in making the goods turned out,



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cannot be measured off into values corresponding to the lots of product. The element of expense is therefore determined by carefully subdividing the outlay into definite classified accounts, and observing the average rate of each in dollars spent per month or other period; and by developing rules by which the sum total of the expense of the period may be divided and set off against the work turned out for immediate or future sale. Finally, the appropriations for future heavy repairs and replacements are provided for and apportioned to the cost of the various lots of work being produced. The cost-record of an item of factory product therefore embodies Material, valued by actual observation; Labor, valued by time-keeping or other methods of computing wages; and Expense, in the form of allowances made by rule in accordance with the value of the equipment and its operating expense in the manufacture of the product. In some lines of business there are such charges as freight, special services, and insurance, enough to warrant an account of "Sundries," following "Labor" and preceding "Expense." All of the items of expenditure in the operation of the factory must be grouped and assigned to the appropriate elementary accounts. The accountant deals with the items as they are paid for, and with the totals; the cost-keeper records them piecemeal, as they are used in factory work, and reports to his superior, the accountant, the totals of his cost-accounts, for comparison to prove the equality of the totals of his cost-sheets with the amounts of the general accounts.

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Of the elements of cost, "Material" is the simplest by reason of its physical presence. It is weighed, or measured, from the factory stock room by a clerk or "helper," and invoiced to the cost-keeper in the same way that it would be charged to any outsider. The value of the material as it is used in factory work is the market price at which it was bought, modified by considerations that involve much study by the trained accountant. The stock may have been purchased at distant points, and freight paid to bring it to the stock room. It occupies space in buildings, and requires racks, bins, and boxes for its convenient storage. Its value lies idle until the material is put to use, and interest on the capital invested for the time of idleness is fairly chargeable. It suffers deterioration by rust, tarnishing, and breakage. In such forms as tubes and bars it cuts to waste, and crop ends and sawdust or chips are produced. After material has been long paid for, defective pieces may be found which are no longer returnable for credit. All these losses and wastes are sources of expense in connection with material in stock, and should be provided for by increasing the charging price above the purchase price of the material. In the long run, the quantity of material put into work will be less than the quantity purchased; but the charging prices will be higher than the purchase prices, and, if the figuring has been carefully done, the discrepancy will be small.

Passing to the element "Labor," some new conceptions are apparent. The factory organization consists of

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a number of persons and an equipment of devices for facilitating this work. The operating force, as distinguished from a mere aggregation of workers, comprises persons of varied capacities, each trained to perform only one portion or class of the factory work. The labor of some of the employees is connected with the purchase and handling of materials; others plan and direct the work; others care for and manage the power equipment by which the machines are operated, and heat and light provided for the workrooms; and still others are foremen, "helpers," or messengers. The list would be extended much further in mentioning all the duties performed in large manufacturing plants by these and other men noted, who are not employed directly in the manufacturing operations on the factory product. For cost-keeping purposes these members of the factory force are classified as "nonproducers." They form no small part of the factory force; they receive their wages regularly, and some of them are paid at high rates; and yet their work cannot be assigned or apportioned to the several lots of factory product which may be in process of manufacture.

The work done on the raw material in converting it into finished product is distinguished as "productive labor," and the workers are accordingly termed "producers." The terminology leaves much to be desired; "producers" do not always produce, while "nonproducers" frequently assist men engaged in "productive" work. Some cost-accountants prefer the qualifications "direct"

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and "indirect," or "distributable" and "nondistributable." The two classes are clearly marked under any of the three sets of terms; "productive" labor can be and is charged directly to the cost of the work done, while "nonproductive" labor cannot be so charged, and stands as an expense to be paid from the income of the factory.

The labor element of cost is thus divided into two classes, only one of which goes directly into the production of goods. There is a similar division in the material account, as small quantities of stock may be required from time to time for general use—particularly in the machine shop, where alterations and improvements are always done with the aid of bolts, nuts, steel, and other supplies taken from the stock room and charged against the shop expense. The third element, "Sundries," contains items which may be similarly susceptible of classification as either "direct" charges to items of factory work, or "indirect" charges to factory expense. The sum of the "direct" charges to any item, lot, or "job" of factory work is the "direct" or so-called "prime" cost. In the small shop of many years ago, where the proprietor was foreman, tools were operated by hand, and clerks and office work were unknown, the prime cost was very close to the true cost. A small percentage added to the prime cost gave the necessary margin to carry the insignificant shop expense.

Improvement in equipment and methods has decreased prime cost, but increased the "indirect" cost

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many fold. For instance, small operations, such as the cutting of screws, are now performed by the aid of expensive standard tools and gauges, with the result of reducing the time and labor cost, but increasing the cost of providing, operating, and maintaining the necessary equipment. A comparison to illustrate this may be made between the country blacksmith shop and the well-equipped jobbing machine shop. The blacksmith's tools are of small value, less than the profits of a single month's work; while the shop equipment may have cost a sum equal to the profits of several years. The blacksmith works his bellows and drill by hand. He sweeps the shop himself or lets it go uncleaned. He requires no extra heat for his building in cold weather, and little, if any, artificial light. If he bases his charges on the value of the entire time employed on the job, and enough more to put his tools in order, his "indirect" expense is evidently close to zero.

In a well-organized factory of even moderate size the variety of indirect expense involved in the operation of the plant makes conditions so complicated that selling prices based on labor and material, that is, on direct or prime cost, are totally inadequate. The proportion of indirect to direct expenditure may become very great in large works employing heavy machinery and automatic processes. Among the indirect items is the wages of foremen, whose time is given to general direction, and cannot be intelligently charged to the cost of individual jobs. Any attempt to distribute foremen's time by di-

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rect charges must result in gross inaccuracy. An active foreman will divide his attention so minutely among the various jobs that he is practically engaged on several at one time. If he is required to make a guess at the amount of time he has spent on each order, he will divide the sum total among the larger jobs, overlooking the small ones and making no note of the time spent in settling disputes, looking over stock material, devising improvements in methods, and other details which occupy odd moments. "Nonproductive" labor by foremen or others is in its very nature an expense not chargeable to direct cost. The crane-tender in his cage overhead runs up and down the shop from one place to the next, often spending only a few minutes on each lift. Sweepers, casting cleaners, handlers of material, oilers, and other helpers are called to assist on this or that piece of work for a minute or half an hour at a time, and most of them are not competent to account for their time with even tolerable accuracy.

The productive work of the factory is facilitated by many other items not properly chargeable to direct cost. Supplies, such as oil, waste for wiping, files and other small tools which rapidly wear out or are broken, and many other things, are used indiscriminately, as required, and cannot be charged to particular items of work in progress. Modern practice lays out liberal amounts in providing and maintaining coat rooms or lockers for the street clothing of employees, sanitary and convenient toilet and wash rooms, and abundance of artificial light when day-

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light is not available. The list of former extravagances which are present necessities is a long one. In the near future every up-to-date factory may include in its indirect expenses sick benefits and accident insurance, entertainment and recreation, and special manual and technical training for its employees. Such general expense cannot be covered by any system of direct charges against the costs of separate orders for factory product. The success of many factories which have gone extensively into the provision of comforts for employees has given color to the belief that these practices bring about an increased efficiency of the workmen which more than compensates for the extra expense. That is to say, direct labor cost as it appears on the cost-keeper's records shows a saving greater than the expense of maintaining the welfare departments.

Other important indirect expense items are connected with the factory buildings. Some of these are ground rent, betterments, and repairs; taxes, water rates, fire insurance, and maintenance of fire-extinguishing apparatus, such as pumps, sprinkler pipes, and hose. Machines and accessories must be kept in repair, renewed and replaced when required. The expense of financing the operation is an indirect charge; interest or dividends must be earned on the working capital which provides for the pay roll each week, though payments on account of sales are on thirty to sixty day terms. Sometimes there is an item of "reclamation," when a reduction in price is made, to satisfy a complaining purchaser, or to compensate for

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a minor defect. Most of these items are present in the accounts of every large business, and some are never absent from the books of even a small concern.

The cost of selling the goods manufactured, though not properly manufacturing expense, is an important indirect expense of the business as a whole. It includes the expenditure for advertising the product in periodicals and mail matter, the salaries and expenses of traveling and local salesmen, interest on the value of consigned stock, office expense of agencies, and all other means used for interesting possible purchasers and securing orders. The selling expense is often a surprisingly large fraction of the total cost of doing business. It ranges from a negligible item in the case of a small shop enjoying a local patronage which comes without solicitation, to perhaps nine tenths of the total expense, in marketing some of the patented specialties which depend upon an artificially stimulated popular fancy.

Some items of indirect cost do not represent any present actual outlay. These are the amounts set aside to compensate for the depreciation of equipment, by creating a fund from which the factory may be kept in its original condition of efficiency. All buildings, tools, and other devices must eventually wear out, or be rendered worthless by the invention of better ways of doing work. Even if kept in constant repair, irreparable breakages may terminate their useful life. It is necessary, therefore, to provide for laying up a portion of the earnings of each tool sufficient to purchase its successor at the end



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of the probable period of its useful life. The result will be that as the shop equipment wears out, a fund will accumulate sufficient to replace it. If all of the factory machinery could be worked to the precise end of its expected life, and then fall suddenly to pieces, a proper depreciation fund would have just then reached an amount equal to the cost of a new equipment.

The total of all these "indirect" expense accounts forms a large portion of the cost of work. In detailing the cost-accounts to show the cost of each works order separately, the "direct" cost of sundries, material, and labor can be exactly charged to each order, but the "indirect" element can be only approximately apportioned by some general method of division or proportion. The accuracy with which the distribution of indirect expense is carried out, so as to make each paying job carry its proper share of indirect cost, while the aggregate of these shares totals close to the actual outlay for indirect expense, is a matter of the greatest importance to the welfare of the business. With incorrect estimates of indirect expense, items of importance being omitted, the works may run at an apparent profit, but an actual deficit. Under competition from factories with correct cost-keeping methods, such estimates will cause the securing of the losing jobs and the turning away of the profitable ones. The result is disaster, either quickly through a deficit in current expenses, or slow but certain when tools and equipment become worn out, and no fund has been created to replace them.

## CHAPTER IV

### INTRODUCING A COST-SYSTEM

THE general plan of the cost-keeping system to be described is essentially simple. The clerical work required is not expensive; and, being reduced to a fixed routine, gives accurate results without unnecessary drudgery. The value of the system rests chiefly in the facilities it provides for quick and ready reference to each and every important recorded fact. These facilities are secured by the methods of indexing, providing for the maximum of accessibility with the minimum of time and trouble.

The clerical work comprises four simple steps—three primary, dealing with the three sets of tickets on which the original charges for Material, Labor, and Sundries are made, and the fourth a secondary and concluding step, in which the three sets of charges are grouped and totaled for the convenience of accounting, administrative, and sales departments. In a very small factory, the last step will be very simple. In a large works, the grouping and totaling must be expanded to afford means for making the comparisons with other items as they are completed. In any case, the expense of cost-keeping, as

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compared with the amounts involved in the factory operation, is very small.

To introduce and put into successful operation a well-arranged cost-system in a new factory is a task worthy of the talents of the expert accountant. But to eliminate waste and errors, and introduce instead economy and accuracy, in a well-established old factory, requires a true diplomat—a type fortunately by no means rare among the members of the accounting profession. It is perfectly simple to print the forms, engage the clerks, and commence the daily work of cost-keeping, among a new force of men without fixed mental habits to be overcome and remade on new lines. In an old works, where the men have grown up with the business, and where the deterioration in producing capacity has been so slow that no member of the force feels himself in the slightest degree guilty, the forms and clerical work are a mere pastime compared with the tremendous task of forcing the combined brain power of the working force into new channels. Each man connected with the factory superintendence is firmly convinced that "book-keeping cannot make money"; and while he may be willing to work twice as hard at his old task, to help things along, he will instinctively hold back from doing his full duty in the new ways. Every accountant who has been through the operation of installing a new cost-system in an old factory realizes the mental strain of the endless patience, tact, and industry necessary to convert the faithful members of the old regime to full belief in the

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advantages to themselves of the saving in mental effort and worry, and of the increased profits of the factory, which will be brought about by the new methods when they are in full operation.

Before making any move to alter existing conditions in an old works, or to install a cost-keeping department for a newly organized factory, a thorough investigation of the conditions should be made. Little harm can be done by allowing existing methods to continue a few weeks longer, while much good results from a preliminary study sufficiently careful to prevent the introduction of changes which will later have to be modified or withdrawn to satisfy requirements which are not anticipated. In an established business it is well to allow the present methods of accounting to continue, and to start the new system parallel with the old and carry it on until the former ways can be dropped without noticeable disturbance.

The condition found in a factory which has been operated for some time without an accurate system of recording costs is likely to discourage any but an enthusiast on accurate methods. There is frequently no attempt to control the amount of material or labor put into the several current shop orders. Materials are issued indiscriminately to any one who may apply; or, in the absence of a stock keeper, each workman helps himself at will and generally leaves the surplus of the lot of parts he took out for his work on the floor or the back of his bench. Very rarely is there a balance regularly struck

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between labor and material, and costs. The moving spirit of a works run with such a lack of system is usually a single remarkable mind. While this one director is able to attend to his work, the business runs at a profit. The progress of time weakens the grip of the autocrat; or financial success brings so much business that he can no longer personally control the mass of detail which he has kept in his own hands; or advancing age with its lapses of memory and increasing fatigue causes the occurrence of mistakes and accidents. When the day's work begins to weigh heavily on the master, the necessity of introducing systematic management by department heads becomes compelling.

The main principles of cost-keeping are alike everywhere, but the application permits of some variation in details to meet special requirements. Alternatives have been suggested only where differing conditions may require a choice. If a form or a system which is in general use in successfully conducted factories seems likely to be unsatisfactory in a particular case, it will usually be found that the case should be altered to suit the preferred system, rather than the system changed to suit what is likely to be a faulty special case. The only valid basis for variations in details of factory accounting is that systematic factory management is closely linked with it, and it is advisable to suit the methods of management or administration to the personalities of the men on whose skill the business rests. Since the managing heads must have their special capabilities, the system may

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properly be arranged to supplement their several weaknesses and take advantage of their strong points. Thus, the man who can plan methods of construction, but cannot remember which job should be taken up first, should be furnished with schedules of times of completing each step up to the last, taken from some routine part of the system. A man should not be given the direction of others in a line in which he is himself weak. The abilities of all the important men are to be studied and used to advantage in carrying out the general plan.

After the accountant has completed his scheme for making the best use of men and facilities, he must select from the printed forms presented those best adapted to the particular requirements of the organization which employs his efforts. While the supply of forms is being printed, there will be time to work out the details of "burden" and overhead charges, as explained in the chapter devoted to that topic. The first direct interference with the existing routine is occasioned by the necessity of obtaining an accurate knowledge of the value of stock on hand and work in progress. This is done by taking an inventory, which, together with the details of the stock-accounting methods, is fully described in a following chapter. The necessary stock room should be located and fitted up, and placed in charge of a careful stock keeper. This man will return much more than his wages by saving the time of "productive" workers, preventing waste, and avoiding the overpurchase of articles which are already in stock or rarely required, the latter being

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the besetting sin of shops conducted on careless lines and with easy profits which cover and conceal extravagant methods. If it is not possible to shut down the works for a sufficient length of time to clear out closets, walls, and benches, collect all the stock material on hand, count it, put it in order, and establish a stock-keeping system complete, it is possible at least to make a list of the items which are regularly to be kept on hand, provide the stock room and the receptacles, and commence stock keeping by counting and transferring the materials on hand, one lot at a time. While the materials are being collected from all parts of the plant, brought to the new stock room, and counted and weighed under the stock keeper's direction, the running inventory should be commenced, so that the amount of each kind of material on hand may always be on record. As each lot is counted, its inventory card is filled out and put in place, and thereafter all issues from the lot are entered and the balance on hand carried forward. When the count is completed, the general inventory can be taken from the cards of the running inventory. It is only necessary to rule off and copy the balances of the various items as shown at the set inventory date.

Under the conditions existing in some old factories there may be found to be an immense accumulation of stock, much of it obsolete or damaged, so that the expense of a complete inventory and appraisal seems too great for consideration. It is possible in such cases to provide the new stock room, transfer and count out a moderate

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quantity of the most useful stock, and establish the running inventory for this lot only. All the rest of the stock is then identified by paint marks on heavy pieces, and the removal of light articles to some designated place, and an account of "Special Stock" is opened with a small arbitrary charge. Thereafter, whenever material from the old stock is found useful and put into factory work, the item is appraised by a quick estimate by cost-clerk or foreman, and the amount is credited to the account of "Special Stock." In the course of time the old stock will be worked into product, or scrapped as its worthlessness is decided, until the remainder is reduced to insignificant proportions and can be disposed of at small expense. The original charge to the account of "Special Stock" should be decidedly low, so that the estimated values of stock of the items as put into factory work may amount in the aggregate to a credit more than sufficient to balance the account.

The valuation of the work in progress presents greater difficulties. In a going concern the value of the uncompleted product is its cost to date, deducting cost of spoiled work, lost time, and errors. At a forced sale the value may be set much lower, because detached parts and unfinished articles are salable in the open market with difficulty. The finished and unfinished parts will be found in all parts of the factory, according to the location of the machines on which the work was being done. The best way is to eliminate finished material and regular stock first by sending it to the stock room. The in-



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ventory then proceeds as later described in more detail, by tagging each piece or lot of unfinished work with a card, stating the number of the factory order to which it belongs, the number of pieces, size and description of the part, and the degree of completion of the manufacturing process. The foremen and other employees familiar with the factory work are assigned to assist the inventory clerks in obtaining this information. Notes should be made on the cards mentioning all interesting points with regard to the items (as, for instance, that a certain part belongs with five others on the floor below). These will be of great help later, when the values of the uncompleted orders must be estimated. The man in charge of the inventory follows the tag men to collect the record cards, first examining each to see that the information is correct and complete.

As soon as the inventory cards are taken up and the material put in the stock room, the factory work may be resumed. At the instant of starting the works after the inventory interval, a new set of factory orders must be commenced. This does not mean that, for the satisfaction of entering factory order No. 1 to mark the new accounting period, any existing numerical series should be terminated. The identification of the several lots of factory product by consecutive numbers is too important to permit of breaking the continuity. The wise accountant will prefer to issue new factory orders for all unfinished work in the shops, following the regular numerical series, if there is one, and to refer in each order to

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the number of the unfinished order it supersedes. In this way the factory starts on the new accounting period with a definite numbered order for every lot of product in process of construction. The accountant will find it no easy matter to prevent factory employees from doing work under old numbers, or with no numbers at all; and he will have to use all the moral force at his command to enforce the observance of his instructions. Cost-sheets are started for the several factory orders, material and job tickets are issued and their use explained, and the system is fairly under way the day after completing the inventory. On the following day the first day's tickets reach the cost-department, the statement of material issued from stock to factory is made up, the pay roll is computed and checked, and the direct charges are entered on the cost-sheets. An extra man or two is provided to assist at first, with the intention of selecting the best when the work becomes familiar and permits of reducing the force.

The work of the accountant in charge is, however, only just begun. From the very first day there will be trouble from ignorance and carelessness, and often from willful defiance of rules, on the part of men who have not been trained to methods of accuracy, and who dislike anything which hinders their direct course toward what they consider the quickest way of doing the work of the moment. It requires more than mathematical ability to avoid unnecessary friction while doing police duty in following up and placing the fault for each infraction of

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the rules. The accountant in charge must keep the peace between men who may have natural jealousies, and, himself a stranger to the compact and solidified group of local employees, must oppose their careless methods, and interfere in the combinations of mutual friendship by which one shields another from the consequences of his mistakes. The accountant's success will depend on the care and persistence with which he follows up each error, and the ability with which he convinces each man of the necessity of faithfully attending to his own duties in connection with the new methods. When the various foremen and clerks are trained to efficiency in their new duties, the supervisor will drop out of the cost-keeping force and return to his work in connection with the general accounts. Thereafter, a cost-clerk will be put in charge of the factory cost-records, under the direct control of the head of the accounting department.

## CHAPTER V

### THE FACTORY ORDER

IN most manufacturing operations the product of the factory comprises different kinds, grades, or series of articles, each made in quantities to suit the immediate needs of the sales department. Each lot of manufactured goods involves the use of machinery or other equipment, occupies more or less floor space, employs certain of the workers, and accordingly differs from other lots in various items of cost. It is necessary in cost-accounting to separate the factory work into identifying lots, so that the administration may know what work is being done in the factory, the production force may control the quantities of material and labor, and the sales department may be enabled to specify to the requirements of its customers, and fix its prices so as to net a profit to the factory. The identification of lots is cared for by the factory-order system, which provides a uniform method of issuing instructions to all departments, each instruction bearing a serial number, and otherwise indexed for ready reference. The same numbers and index arrangements serve for the cost-records corresponding to the factory orders, and provide means for conveniently finding any desired cost-sheet for either current or completed

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work. The factory-order system has therefore an important bearing on the cost-keeping work which it controls and keeps in order.

The military system of government—one man in supreme control directing the work of all others by definite orders—is the feature of successful factory management. Even in organizations so large that the details are too numerous for control by one man, the military system may be retained by dividing the responsibility among specialized leaders, each in control of a separate field. There may thus be several “functional foremen,” one having charge of laying out and setting up the work; another, of the speed at which machinery is operated; another, of the conduct of operatives; and a general superintendent, or control by committee methods, to hold the organization together. In any case, the instructions for doing work must be in the form of concise written orders. The responsibility for errors is thus positively fixed upon either the man who wrongly ordered or the man who did not obey.

All orders for the making of factory product originate in either administrative or sales departments, and are addressed to the production department. The most desirable orders are those based on actual sales, for these when shipped give rise to accounts receivable, which will later provide funds for the ever-urgent pay roll. Sales orders come in through the sales department, and are reviewed by the administration only with regard to credits, terms, and general desirability. Next in order are

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factory orders for finished product to be stocked in preparation for expected sales. These orders are suggested by the sales department, but entered only with the consent of the administration, to the end that the works may not tie up too much capital in articles which may not, after all, be needed for shipment, but remain in the store room longer than expected. These two groups of orders are for finished product. Next comes the important class of "finished-part orders." Many portions of standard factory product are preferably made in large lots, either to reduce labor cost, or to provide a supply of similar parts (as standard screws or bolts) for use on several kinds of product, or to provide work for certain machines or men during temporary slackness. Finished-part orders, unlike the previous group, originate in the production department, but are subject to supervision by the administration, along fixed lines. The works manager or superintendent is the proper judge of the advisability of doing work on finished-part orders; but the financial head has the right to prevent the accumulation of quantities of stock parts greater than justified by the state of the funds, or the condition of business. The necessary supervision is preferably exercised by the establishment of minimum quantities of each finished part to be kept in stock, and of stated quantities to be ordered and made up to replenish each kind of part as the stock falls to the specified minimum.

Contrasted to the orders for product are the orders for factory expense items or "nonproductive" expendi-

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ture. The terms "productive" and "nonproductive," though in general use, are not properly descriptive. Strictly speaking, many of the helpers who assist in the factory work perform labor no less "productive" than that of the men they assist. All workmen employed in general capacities, including foremen, crane hands, engineers and firemen, sweepers and watchmen, forming a numerous class in large factories, belong to the class called "nonproductive," in the sense that none of their work can be charged direct to product orders. To keep an accurate check on the nonproductive expenditure, it is best to issue a factory order for each important item. By this course every moment of time and every item of material and supplies used for shop upkeep or improvement is charged against a definite shop order, either numbered in the regular series or otherwise identified by some symbol.

According to the articles manufactured, factory orders may differ in quantity only, as in making a uniform product, such as cement, or one kind of buttons; or they may differ one from the other in size of items, as in building various sizes of engines of the same pattern; or they may cover a wide range of diversified articles, as in a general repair shop. All orders, whether for product, finished parts, or factory expense, are classified for reference by affixing designating letters to their serial numbers. Thus, engine orders may be indicated by the letter "E," boiler work by "B" finished parts by "F," shop expense by "S," etc. The first order of a certain

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day may call for boiler work, and being assigned the next unused number, say 1202, becomes 1202 B. If the next is an order for stock bolts, it would be No. 1203 F. There may be as many of these classes as the accountant finds desirable for setting forth the amounts and profits in the several kinds of work done.

In entering factory orders from sales, each lot should be assigned a number as soon as the transaction is completed and the papers certifying to the fact are in hand. If the date of completion is far off, so that it is not necessary to put the order in the shop immediately, the numbered forms may be attached by a wire clip to the correspondence or written order of the customer, and the whole laid aside for attention a little later. It is a fortunate condition to have in hand orders whose desired shipping dates are so distributed as to keep the factory comfortably and fully employed for a long period. For best working efficiency, orders must be scheduled for delivery so as to avoid the alternation of overspeed with slackness and the laying off of skilled help. Whatever latitude is permissible in scheduling the work should be taken advantage of by the works office, so that the commencement of the work on each order may be arranged in accordance with the facilities of the shop and the promised shipping date of the completed order. When it is necessary to send designs or specifications to the purchaser for his acceptance or approval, instructions to the factory must necessarily be withheld until the acceptance is at hand. In such cases the factory order



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should be filled out, but the instruction copies intended for the works should be laid aside until the work can be started, while the card-index copy and the cost-clerk's copy are put in place at once to serve their part in the system.

Finished-part orders may be used to advantage in keeping the works employed at a desirably uniform rate, and to prevent confusion in cost-keeping. It is impossible to insure that a workman carrying through a lot of five similar pulleys to be used on four different jobs will correctly charge his time on two of them to one order and on the other three to three separate orders. By entering a finished-part order for making the five pulleys as one lot, the labor cost will probably be reduced, and the cost-clerk can easily and correctly charge the proper fractions of the total cost to the product-orders on which the wheels are used. It is often desirable to make a number of articles on a single finished-part order, some for present use and the others to be put in stock for future needs. Orders for finished parts are to be entered only for actual needs, or in accordance with specified rules as to quantity to be made up ahead, or with the consent of the administration in special cases where the need of work for certain tools or men is great and justifies piling up surplus stock. The sales department, by reason of its knowledge of prospects, may be in position to advise the production department in such an emergency.

There is still another class of factory orders known

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as "assembling" or "completing" orders, which are used in certain kinds of manufacturing. For instance, finished parts may be taken from the stock room to be grouped and assembled into finished articles ready for sale. Sometimes completed goods are only partly finished before putting in stock to await sale, and must be painted or finished before shipment as the purchaser may direct. The parts or partly finished products are therefore completed on assembling orders, entered in the same numbered series, but so worded as to make clear to all concerned the exact source and condition of the unfinished parts or devices that are to be worked upon. The cost-clerk accordingly expects to receive notice not of items of raw material, but of issues from the finished-parts stock; or if a partly finished device is to be completed, he turns to his original cost-record, enters the amount on the new cost-sheet, and proceeds to add the further charges for sundries, material, and labor as they come in. The "assembling" order may be nothing but a direction to ship a completed article from stock, in which case there may be no additional cost-items, and the order becomes a mere record of shipment.

It is of the greatest importance that all factory orders should be entered by one reliable, competent, and careful clerk. All instructions for the factory, whether received by telephone, mail, or orally, are referred to him for translation into shop language. He should have the faculty of remembering peculiarities in each regular customer's methods or terminology, particularly those

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which have also occurred on earlier orders, and so of understanding the customer's real intentions, even when they are obscured by carelessness or omissions. A good order clerk will not fail in taking oral orders to ascertain the name and position of the individual talking, the dimensions and details required in making up what is wanted, and all other information which will insure the doing of the kind of work which the customer desires. In a factory producing a wide range of articles, the order clerk must be a man of great resource and tact. As steady patronage and repetition of orders is due in great part to the satisfaction given to customers by the order clerk's correct interpretation of their often obscure and careless instructions, a thoroughly competent order clerk is almost invaluable.

Simplicity, directness, and accuracy are the characteristics of good shop orders. Many hours' labor are wasted, much material spoiled or thrown away, and valuable profits lost by hasty and ill-considered instructions to the working force. The office man should do all the preliminary thinking, and the factory force should act accordingly. In entering orders, all necessary time should be taken to get the facts and state them in plain language. In no case should important information be omitted without stating when and how it will be supplied. Instead of vague terms such as "make as directed" or "to be explained," the form should be explicit: "As their Mr. Smith will instruct our Mr. Jones," or "To be explained to Mr. Brown by their representative, who is

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expected here to-morrow." In the absence of such definite information, it may be surely expected that foremen and workers will either lay the order aside until some one happens along with the lacking word, or waste valuable time in search of the unknown man about the plant who may have personal knowledge of the expected course of procedure. The time spent in putting the factory order in shape will pay the cost many times over in increased efficiency of the factory force.

All factory orders should be entered on similar forms and numbered in a single series. No work whatever is to be done, and no material is to be issued, or factory bill paid or goods shipped out, except in accordance with the instructions of a factory order. This rule is fundamental. If it is invariably obeyed, no item of expenditure can go unaccounted for, and no shipment can escape being charged on the books; for each number in the single series stands open until the work it designates has been reported finished and the goods are delivered to purchaser or store room.

Fig. 4 is the factory-order form and its duplicates as they are used in communicating information to the various departments interested. Each department handles its copies in accordance with its particular needs. The general office arranges its copies numerically to facilitate checking the issuing, completing, shipping, and billing, and to prevent the overlooking of any order; and maintains also an alphabetical index for use in finding the numbers corresponding to known names. The cost-

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keeper files his copies numerically. The shipping department uses an arch file carrying unshipped orders only, arranged according to expected dates of shipment.

MEMORANDUM COPY OF FACTORY ORDER			
INDEX COPY OF FACTORY ORDER			
FOR Acme Process Co. - 1422 Broadway	DATE Jan. 1-10	No. 12785	
SHIPPING CLERK'S COPY OF FACTORY ORDER			
FOR Acme Process Co. - 1422 Broadway	DATE Jan. 1-10	No. 12785	
COST DEPT COPY OF FACTORY ORDER			
FOR Acme Process Co. - 1422 Broadway	DATE Jan. 1-10	No. 12785	
OFFICE COPY OF FACTORY ORDER			
FOR Acme Process Co. - 1422 Broadway	DATE Jan. 1-10	No. 12785	
New York.		Letter JSS	1921
SHIP TO No. 2 Works	DATE 1-5	DATE SHIPPED Jan 5	
Monmouth, N.J.		ORDER NO.	DATE SHIPPED
VIA PRR	CHARGES Pd.	DATE SHIPPED	DATE SHIPPED
3Steel Forgings from their B.P. A-1411 Return print with pieces.			
EXTRA COPIES TO M.S.-Forge.			

5 x 8 inches

FIG. 4.—FACTORY-ORDER FORM.

The foremen and stock keeper file their copies on arch boards; or hang them on racks in plain sight, each order fully exposed.

The sheets should be filled out by typewriter with carbons, running the form twice, if necessary, to secure a sufficient number of perfectly legible duplicates. Each

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blank shows by its heading its proper destination, and each space is designated for its intended use. On the first line is written the name of the person or corporation to whom the work is to be charged, and on the second line the complete mailing address to which the invoice is to be sent. On the third line is written the name of the party to whom the goods are to be delivered, and on the fourth the exact shipping address. On the fifth line, after the word "via" is written the desired method of shipment, whether freight, express, team, messenger, or otherwise; and following, after the word "charges," either "Collect," "Paid," "Free," or whatever other description is appropriate. To the right of the vertical division line, in the first space is to be filled in the date the order is made out; and following, the consecutive number of the order, the latter being supplied by the printer to insure that no numbers shall be omitted or repeated through error, as might occur if the numbers were filled in by the typewriter. On the second line, in the space designated "How Ordered," is entered the necessary data to record the authority by which the order was entered, whether orally, by telephone or letter, or formal purchase order of the customer, or by direction of the proper officer of the works; or the initials of the men from and to whom the instructions came, as "RFS to TMS." In the adjoining space is filled in the customer's order number, or the date of the instructions if no number is given. On the third line is provided space for the initials or name of the general manager, or other desig-

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nated authority, who is to note and approve the terms of each order; and opposite is written the date of shipment desired. On the fourth line is provided space for the O. K. of the foreman who inspects the goods when they are ready for shipment to see that they comply with the requirements of the order, and opposite, thus falling directly under the date wanted, is the space in which the shipping clerk is to enter the actual date of shipment. On the fifth line is the space for date of invoice. Below the line the card is left blank for the insertion of the description of the work required.

In works comprising several departments, many orders require the coöperation of two or more foremen with their forces of men. Extra copies of each order are therefore made on blanks printed on manila paper. By filling in across the bottom of the order sheet the names or numbers of the various shops to which copies are to be sent, the typewriter can determine how many extra copies should be made, and the order clerk after checking the wording can underline on each copy the particular department to which it is to go. In this way all departments have identical copies of the order, and while each is concerned only with its work, its foreman is at the same time informed regarding the work done by others which concerns him. It should be understood that all the spaces will not necessarily be filled on all order copies. The date of actual shipment, for instance, remains blank until the shipping clerk supplies it on his copy. The shipping clerk's copy is sent to the office with the signed

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bill of lading, or the signed receipt of the customer when the goods are delivered in the same city by team or messenger. The office inserts the date of actual shipment on its own order copy when notified by the cost-department that the order is complete. The O. K. of the credit man will naturally appear on the office copy only. The signature of the office manager will also be on the office copy, and the signature of the works manager or shop superintendent may be put in the same space on the copies intended for the shop. These matters are self-explanatory upon consideration.

An excellent method, much in use, is the making of an extra carbon copy of each works order as entered from the instructions of the customer, to be mailed back to the latter as an acknowledgment of the acceptance of his order. In this way the customer has placed before him a copy of the instructions to the shop almost as soon as work is commenced, usually in time for him to correct any mistake which may have been made, and thus prevent possible dispute or loss. The acknowledgment copy often carries a promise of delivery at a certain date, or a disclaimer of responsibility by the shop against claims for damage or loss by fire or accident, and these statements, if received without comment, are presumptive against the customer in case of later dispute.

It may be desirable to omit on shop copies the name of the customer or the destination of articles when completed. In old established works, foremen and others form a habit of filling orders from memory, without ref-



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erence to drawings, so that repair parts of a certain style are confidently sent out for James Roberts's crusher because Tom erected it and thinks he remembers just what size and style of parts were used. Such methods cause numerous mistakes and serious loss of reputation. Another objection has been found to the publishing of names—that lists of customers have been obtained from employees by competitors, or made up by railway clerks or other observers for interested parties. By the simple expedient of sending orders into the shop with the space for name of purchaser left blank (easily managed by cutting away a properly shaped section of the carbon papers which print the shop copies), employees may be prevented from relying on memory alone, and the knowledge of the destination of goods restricted to confidential clerks.

The form is of the standard five-by-eight card-index size, and will be found large enough for all practical purposes, with possible modification in the case of the cost-department and works copies, which, if preferred, may be extended to eleven inches in length, to permit of printing or typewriting a fuller description of the work below the summary. The details of fittings and equipment for an engine or boiler, or other extended list of items, may thus be set forth in full. The alphabetical index is provided by filing the fourth copy of the order, which is printed on thin tag board. This index will supply the numbers of all previous or current orders of any customer whose name is known, or the numbers of stock or special orders

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under their proper headings, and will be found extremely useful and economical of time and effort.

The use of the metal signals made for card-index purposes will be found a convenience in connection with the card index of shop orders. By providing an index card in each drawer to show the meaning of the signal in each of several locations along the top edge of the card, orders for special apparatus may be readily designated. For instance, all orders for 10 x 10 engines may be indicated by a signal placed on the left-hand end of the card; those for 12 x 12 engines, by signals placed one inch from the edge of the card, etc. The shop orders may be grouped under two or more classes, as land and marine work, or flour-mill and saw-mill machinery. It is also convenient to keep a signal at the right-hand end of each card representing an order which is not yet shipped. If this is done, the order cards may be placed in the index as each order is entered, and left there indefinitely, the presence of a signal showing the observer that there is an order which is not yet completed. As the index grows, the time will come when it will be necessary to transfer the old cards to a suitable place of storage. Such transfers may be made once a year, or oftener if required.

The factory-order system would not be satisfactory without provision for handling matters which turn up suddenly and must be put through with the greatest possible expedition. Such provision is especially necessary in small shops where only one typewriter is employed, who may be momentarily absent. Orders taken by tele-

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phone, in particular, come in at unexpected moments, and being taken down by anyone who happens to be on hand, are liable to incompleteness, due to the forgetting of some important detail by the recipient. There should be a memorandum form at hand ready for use in entering such orders. Various special forms have been devised, but when one faces the requirement squarely there seems no possible reason for using anything other than the regular order form. Memorandum forms printed on manila paper are therefore provided, padded for convenience. The manila blank is equally convenient for the entry clerk in putting into shape for typewriting orders received from correspondence or miscellaneous data. When it is desired to start work quickly, as in the case of rush repairs, it is only necessary to write out the order on the scratch pad, fill in the next shop-order number, detach from the order-pad the four sheets belonging to the next order, attach them to the pencil copy by a wire clip, and direct the shop to proceed immediately with the work, the written order to follow shortly. The typewriter can then fill out the sheets and send out the various copies later, in time to serve all practical purposes as usual.

## CHAPTER VI

### THE COST OF MATERIAL

THE first step in filling a factory order is to find the material. If the necessary articles are on hand, work can be commenced instantly; if not, there may be delays from the moment the lack is discovered to the final payment from the buyer of the finished goods. The system of ordering, purchasing, receiving, storing, issuing, and charging materials should be comprehensive and effective. The routine work forms an important part of the duties of the cost-keeper.

The administration purchases and pays for the materials through a purchasing agent, exercising general control over quantities and prices. The production department calls for qualities and quantities by requisitions made out in accordance with factory orders or needs. The sales department has nothing to do with material except to the extent of advising upon occasion as to probable impending sales and the requirements that they may impose upon the factory. The accountant, belonging as he does to the ruling department, the administration, controls through his cost-keeping department the whole system of supplying materials to the factory.

Three classes of materials are to be recognized, name-



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ly, supplies, stock, and specials—a convenient alliteration. “Supplies” comprises materials which are used indirectly and indiscriminately to facilitate work, and not chargeable to any definite manufacturing order. Such are fuel and packing for the power plant; waste, files, and sandpaper; shovels, pickaxes, and riddles; chalk and chemicals. “Stock” comprises articles usually kept on hand ready for use or sale, such as pipe and fittings, bar steel, stock castings and forgings, and the like. “Specials” are articles required for special construction or sales, but not regularly carried in stock, so that they must be ordered in each instance to suit the requirements.

It is the duty of the production department to notify the purchasing agent, as the representative of the administrative department, of the quantity and kind of materials to be bought, and the date each lot will be needed for factory work. The notice is by requisition (Fig. 5) filled out by the stock keeper, except in certain special cases to be noted below. For articles belonging to the classes “Supplies” or “Stock,” requisitions are made out immediately upon issuing a lot of the goods which brings the amount remaining in the bin below a previously established minimum. The spaces of the requisition form, which is filled out in triplicate by the use of carbon paper, provide for entering the quantity and description of goods, the purpose (“stock” or a particular factory order) for which the goods are intended wholly or principally, and the quantity remaining in stock at the mo-

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ment. The requisition carries but one kind of material, likely to be ordered in a single lot and from a single source of supply. Below the list of quantities and sizes of the material, the spaces provide for the initials of the person making out the requisition, the approval of the works manager or superintendent, the date the goods will be wanted for use, and a suggested source of supply, if the construction department has any preference or is bound by specifications. The making of the requisition is checked by entering its number and date on the memorandum card or inventory page, so that a second may not be issued, and so that unusual delay in receiving the new supply may be observed, and steps taken to hasten the replenishment. In case the stock keeper knows that haste is necessary to avoid a shortage, he indicates this on the requisition; otherwise, the purchasing agent decides for himself, or investigates to ascertain, the time of delivery required for such stock articles. A copy of the requisition remains with the person who issued it, to guard against loss or mistakes; and the remaining copy is sent to the cost-department.

For articles of the class "Specials," notice of their requirement originates either with the person entering the factory order, or, if there overlooked, with the stock keeper when he is called on to deliver something not in stock. The requisition for an article not regularly carried gives the factory-order number for which it is intended, and is sent first to the works manager or superintendent, instead of direct to the purchasing agent, thus

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giving an opportunity for the chief authority to arrange for substituting a stock article if possible, or to issue special instructions or specifications, or to cancel the requisition if by any chance it has been anticipated by another. Such a requisition is noted by entering its number and date opposite the name of the article on the construction department's bill of material or copy of the factory order. The cost-keeper, noting that such a requisition bears a shop-order number, immediately enters a memorandum on the material charge sheet, thus preventing overlooking an item of cost in case the charge for the special material should be delayed.

In some cases "stock" articles practically become "special" purchases, as when a factory order calls for some ordinary stock article in greater quantity than is usually carried. The special quantity is then ordered exactly as if it were a "special," and the amount on hand and the construction-order number are both entered on the requisition. Small lots of special supplies, as tool steel for trial, unusual office supplies, and the like, are ordered by requisition made by the stock keeper upon request of the proper foreman or other person, and passed up for the manager's approval as in the case of other special stock.

The purchasing of materials for a large factory is one of the most important functions of the administrative department. The work employs the services of a specialist, whose mercantile sense and training cannot be too highly developed. In addition to the commercial



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faculty, the purchasing agent must have a minute and accurate knowledge of the grades, qualities, and possible sources of supply of all the materials used in the factory. The failure of the purchasing agent to secure the goods requisitioned by the production department at the time named for delivery will increase costs by disarranging the schedule of factory work, and may even shut down the plant. An alert purchasing agent will generally have a second source of supply ready to make an instant delivery which will compensate for a perhaps higher price.

Some materials are purchased at a price per pound, fixed by general market conditions, and daily reported in journals of trade; others are sold at prices maintained by general agreement, and may be purchased from any of several sources of supply, with the certainty that the same specifications will be met, and with the only choice offered by the variation in the times of delivery which will be granted by the different parties offering; while others have price lists depending on a fixed base figure, altered by an addition, or a special discount, for all sizes or shapes departing by a certain stated amount from the size on which the base price is fixed. The market to-day is immense in the variety of articles offered, and the purchaser of materials for an extensive business cannot study too carefully the possibilities of hitherto untried sources of supply. He should keep himself informed of improvements in lines in which his purchases are made, and study market conditions so as to anticipate probable

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changes in price of staples which will affect the cost of the products of the business. The attempt to anticipate is, however, allied to speculation, and is legitimate only to a limited extent; for, in general, it is not proper in a manufacturing or contracting business to take orders which are not protected by standing quotations for the necessary materials, or to purchase ahead of requirements large quantities of stock which might fall in price and be later used only at a loss.

The requisitions reaching the purchasing agent are used by him as a basis for issuing orders to the various sources of supply. Guided by time requirements entered on the requisition, or known to him, he is able to group items and in some cases to increase quantities, to place his orders to the best advantage, and to assist the work by paying higher prices when necessary to secure quicker delivery. As each requisitioned item is ordered, the purchase-order number and date is entered below, and the name of supply house and expected date of delivery of the material is entered on the requisition stub, which is then torn off and sent back to the department which issued the requisition, to give notice when the material is expected. Upon receiving this stub the stock keeper enters the information on his own copy of the requisition. When the material is received the stub of this copy is torn off; so that the projecting stubs remaining show which requisitions have not been filled. The purchasing agent files his copy of the requisition in a date "tickler" under the expected date of receiving notice of shipment,

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and notes this date on his record copy of the purchasing order.

To <u>Crane Co.</u>	Ship to <u>140</u>
<u>N.Y.</u>	<u>Private Delivery - Elizabeth, N.J.</u>
Via <u>PAK</u>	
Please furnish the following for account of U. S. MANUFACTURING CO., N. Y.	
20 lengths 1" Old Pipe 5 pcs 3" - - -	ca. 9 ft long, cut & threaded
These goods are wanted <u>Jan. 10</u>	
Bill for goods to us without a written order on this form. Order orders will be confirmed in writing. Acknowledge receipt of this order immediately, advising when you can deliver. Send bill of lading with invoice at time of shipment and give us your bill this	
ORDER NUMBER <u>2850</u> U. S. MANUFACTURING CO., Date <u>Jan 1</u> 19 <u>18</u> By <u>D. Walden</u>	
These goods are wanted <u>Jan. 1 - 1918</u> Ordered for <u>Stock - 1418</u>	
REG. NUMBER <u>9593</u> ORDER NUMBER <u>2850</u> Date <u>Jan 1</u> 19 <u>18</u>	Not Shipped

5 x 8 inches

FIG. 9.—PURCHASE ORDER.

The "not-shipped" stub is to be torn off when notice of shipment is received by the purchasing agent.

The purchasing order (Fig. 6) is filled out either in duplicate, the copy being filed serially, or in triplicate, leaving an extra copy. In a large and complicated business the duplicate system is preferable, and in this case a purchase record book is kept, made of loose leaves like Fig. 7, each page carrying a separate item, like the pages

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of the stock inventory book. In a horizontal line and under proper column headings are set down order number, date, name of party, quantity, size, description, construction-order number for which intended; and invoice date, amount, list price per unit, discount and freight charge, all the latter obviously being filled in subsequent to the first entry. For a smaller business, it is possible to index the purchase orders themselves, so that one item or class only shall appear on a single order, and the record copy may then be filed, alphabetically and in order of size, according to the material ordered, thus saving the labor of indexing, but giving a bulkier file, rather less convenient for reference.

The purchasing agent's later duties are guided by the "tickler" mentioned. Each day the removal of the front card shows up the requisitions for articles, invoices for which should be received that day. If no notice of shipment is received, the seller may be written or telegraphed, allowed a day's grace, called on to delay shipment, or left to his own time, according to requirements. Invoices received go first to the purchasing agent, who thereupon removes from his "tickler" the corresponding requisitions. In case of shipments far ahead of the expected date, the requisitions may be readily located by the date of shipment expected, entered on the order copy. The date and amount of invoice are entered in the purchase-record book, if this is used, and the invoice is sent to the cost-keeper, while the freight bill or a memorandum notice is sent to the receiving clerk.

13 1/2" x 11" Type-Block

NO	DATE	QUANTITY	DESCRIPTION	UNIT	REMARKS	QUANTITY	DATE	REMARKS	QUANTITY	DATE	REMARKS
104	2610	1 1/2	Cross	2"			11-4	11-9	11-5		
105	2701	2	Round	3"			12-5	12-5	12-31		
106	2718	2	"	3 1/2			13-18	13-18	13-31		
107	2822	2 1/2	Cross	1"							
		5		3"	9 ft. long						

14 x 10 number

Fig. 7.—PURCHASE-ORDER RECORD.

## COST-KEEPING FOR MANUFACTURING PLANTS

This system of requisition and purchase order will be observed to afford means of tracing the progress of each order for material from start to finish. If the construction department wants to know whether "specials" have been ordered, the factory order, or the regular bill of material, will show it by the presence or absence of the requisition number. The stock keeper can then state where the material is to come from, and when expected, by reference to the requisition in its order; or the purchasing agent can tell by his index the same facts, using the name of the articles as his starting point. If confusion occurs between similar specials, as, for instance, several shaft forgings for different jobs, the factory-order numbers opposite the several items will show clearly whether one has been forgotten. The order index (Fig. 7) also shows who furnished the last lot of any supplies, and the price, quantity, and date of delivery, and is thus useful as a guide in modifying the stock quantities from time to time, and in preventing either delay from lack of stock or unnecessary expense by carrying too much on hand. While the detail work required is simple and inexpensive, the results secured will be very gratifying.

Each shipment of goods received by the works is to be inspected, weighed, measured, or counted to verify the quantity and detect loss or damage, and the facts recorded on a receiving memorandum (Fig. 8) in duplicate. These forms are best bound in books, the original copy to be detached, while the book copy remains in place to

## THE COST OF MATERIAL

provide a continuous record of all goods received, in the order of their arrival.

The right-hand blanks from fourth to seventh are for initials of clerks, who thus certify that price and ex-

U. S. MANUFACTURING CO. RECEIVING MEMORANDUM (One lot and one kind of Material Only)				PUR. ORD. 2788
FROM <i>Sumner Co.</i> .12.19... 1910				FAC. ORD. 1120
.....				CHGS. (Paid)\$.....
.....				PRICE OK.....
Pcs.	Weight	Size	Description	EXTS. OK.....
2	305	3½'	<i>Dick. Rip - full lengths</i>	ENT'D COST DFT.....
				ENT'D ACCTS. PAY.....
				ACCT. MAT.—ADM. SELL. SUND.....
				APPROVED .....
				VOUCHER NO.....

8½ x 3½ inches

FIG. 8.—RECEIVING MEMORANDUM.

tensions of amounts are correct, and that the figures have been entered. The eighth space is for check-marking the general account to which the purchase belongs. The ninth is for the initials of the manager or treasurer, and the tenth is for the serial number of the voucher, supplied by the bookkeeper.

This receiving memorandum fills a double purpose. It is a common practice to stamp a diagram, or attach a paster, to each invoice received, on which the necessary notations are made, to inform those interested that the

## COST-KEEPING FOR MANUFACTURING PLANTS

articles were received, freight charges paid or otherwise, price correct, and the like. By placing this form on the receiving memorandum, one paster does the work of two. If several shipments are invoiced together, the corresponding receiving memoranda are pasted together and to the invoice, but the top one only is completed by filling in the notations for passing the invoice. The paste is best applied at the upper left-hand corner, or the sheets can be gummed in the same place in advance. The purchase-order number is applied by the receiving clerk from his requisition copy, with the factory-order number when one is designated, and he also supplies the amount of transportation charges, stating whether prepaid by the shipper or not. The receiving memoranda, thus filled out, are sent to the cost-keeper for his information and further use.

Having checked in the articles, each lot is to be put promptly in its proper place. There should be a definite yard, shelf, bin, box, or position for each kind of material, marked and indexed so that there will never be a moment's doubt as to where an article is to be put or found. There should also be a system of recording issues of stock material, in such a manner that the quantity remaining on hand may be always known. These requirements are of fundamental importance, and yet are disregarded to an extent which would never be permitted if the serious losses resulting from shortages, over-purchasing, searching for mislaid items, and deterioration of stock from age were not so difficult to meas-



## THE COST OF MATERIAL

ure accurately. The first thing to do in systematizing an old works or laying out a new plant is to arrange for the delivery of materials through one inlet, where proper record of receipt may be made, and to provide suitable and convenient places of storage, in a stock room in charge of a competent man. Some materials can be stored in yards outdoors, like large castings and forgings. Others must be protected from the weather. Some must be locked up to prevent loss or theft—like small brass parts. Bright metal goods must be kept in a dry atmosphere, or carefully wrapped or greased for protection. Varnish and oils must not be kept in too dry a place, as the wooden barrels will shrink and leak; and such inflammable liquids need extra protection against fire. In a well-ordered works, every article has its own well-chosen place of storage, suited in arrangement, capacity, and location to the requirements of convenient use. The three fundamentals are accessibility, to save time and transportation; order, so that anything may be found at a moment's notice, and duplication or overlooking of items avoided; and compactness, so that one chief storekeeper may keep watch of the whole receipt and issue of material. In locating the stock room, consideration should also be given to future needs and possible changes, as the moving of an entire stock room with bins and their contents is a most expensive and disturbing process.

To comply with the requirement that the amount of each kind of goods in stock shall be always known, some

## COST-KEEPING FOR MANUFACTURING PLANTS

form of running inventory must be kept. The simplest method is by providing a card on each stock bin or box on which all receipts and issues are to be recorded. This operates particularly well in connection with the arrangement of stock room sometimes called the "two-bin system," and consisting in providing a double compartment for each lot of stock. From one bin all issues are made until it is empty, and into the other at the same time all receipts are placed. When the issuing bin runs out, the fact is reported, and the next lot of the material wanted for factory use is taken from the other bin, which now becomes the issuing one, leaving the empty bin to receive the next lot that comes in. The memorandum card, or a simple tag, hung on the issuing bin, and transferred as necessary, shows the stock keeper which bin is serving in this capacity. The actual cost of the partition is so small that the extra expense for the two-bin construction is inappreciable.

In a factory large enough to require more than one stock room, the running inventory is best kept in a card or loose-leaf ledger in the general cost-department. The expense of maintaining such a record may be covered many times in a single year by the saving of time of high-priced men, and by the reduction in interest charge on idle capital. The inventory sheets or cards are shown by Fig. 9. They should be indexed by tabs or guide cards so completely that it will be much easier to ascertain the presence of an article by looking in the record than by hunting for the object itself. To prevent dupli-



## COST-KEEPING FOR MANUFACTURING PLANTS

cation of material, the location of each lot is given on the record, together with the minimum amount to be carried in stock, and the proper quantity to order when the stock needs replenishing. These amounts can be easily estimated after the stock record has been kept up for a few months, by observation of the quantities used hitherto, and consideration of the probable time required for delivery of new material from the manufacturer.

For articles which are too bulky for storage in the stock room, numbers should be assigned, and each piece of a lot marked with its own serial number, and recorded on the books, so that it may be identified at any time. If such a large piece is used, and through carelessness no requisition is turned in for it, the number will attract attention and make the supplying of the omission almost certain.

For cost-keeping purposes, materials are of two classes: unfinished, or rough, and finished, or worked. These terms are relative only. Unfinished materials comprise those which are kept in stock in the condition in which they were first delivered. Finished parts include all those on which work has been done by the shop since their receipt. Finished parts, like unfinished materials or "stores," are recorded on stock-ledger cards as received, giving quantity, description (name by which known), from whom received, and gross value delivered and ready for use by the factory. The record form for finished parts is shown by Fig. 10. The use of its various columns will be explained on a following page.



## COST-KEEPING FOR MANUFACTURING PLANTS

Having arranged for the purchase and storage of the necessary materials, the method of charging out this material as it is used in the manufacturing processes must next be developed. The first consideration is the value of the material as it lies in its place of storage. This value is somewhat more than the market value of identical material which may be purchased from neighboring sources of supply, for the cost of handling and delay must be added to the quoted price of material from outside sources of supply, while the material on hand in the storeroom can be had instantly upon call, without contingent delays of workmen or expenses of clerical work in connection with purchasing. It is therefore unwise to sell from factory stock materials carried for the factory work, except at a price sufficiently above cost to make up for the loss due to handling the material twice—once when it was purchased and put into storage, and again when it is taken out. It is often more profitable to place an order with local jobbers for such stock material to be delivered direct to the customer than to fill an order with articles from the factory stock room.

On the other hand, keeping material in stock involves a loss of interest on its purchase price, so that its cost to the concern increases with each day it lies idle. In disposing of articles which have lain too long in stock, a loss may be necessarily incurred. There is no good reason for hiding the fact by holding the articles for some lucky sale at an extra price, for similar articles might then be purchased at market price to fill the order

## THE COST OF MATERIAL

at the same profit. The true value of a stock article is the price at which a similar article could be obtained instantaneously, or at least with sufficient rapidity to suit the requirements of the transaction. The extra cost of keeping the articles in stock, made up of the addition to the purchase price of freight and other transportation charges, interest for the period between payment of the invoice and the actual use of the articles in the work of the factory, rent of storage space and facilities, wages of stock keepers, loss and shrinkage in use, as by saw cuts and short pieces, defective parts found in large lots, and other contingencies, is the price paid by the factory for the advantage of having material ready for immediate use. That this advantage involves expense should never be forgotten in purchasing, handling, and charging material.

It is proper, therefore, to recognize the existence of this expense by an increase in the price at which material is charged out to the shops. The increase will not be large, and may be determined as a percentage with fair accuracy by computing the cost per day for interest, insurance, etc., on the value of the stock ordinarily carried, on the basis of the length of time for which the average article lies in stock from its receipt at the factory to its issue to the factory workmen. All freight charges and expense for cartage and handling are properly added to the net invoice price of each lot as received, and the percentage for interest and depreciation should be added to this.

## COST-KEEPING FOR MANUFACTURING PLANTS

The cost of material is therefore to be determined from the invoices, by adding transportation expense, and a percentage for expense on material in stock awaiting use. As each lot is received, its total value is computed and added to the value of the quantity on hand, as shown by the running-inventory cards (Fig. 9), and the total value is then divided by the total quantity to give the unit charging price at which the material is to be entered on the factory cost-sheets. By averaging the value of the fresh supply with that of the remaining lot, the effect of market fluctuations is reduced, and changes in stock-material prices are rendered less abrupt. As each invoice reaches the cost-keeper, it is filed temporarily in an alphabetic file by name of shipper. In the same file are placed the receiving memoranda (Fig. 8) as they are received from the stock room. When invoice and memorandum relating to the same shipment come together in this way, they are attached by pasting, and the value of the arriving shipment is computed and entered on the cards (Fig. 9), after which the invoice and memorandum are sent to the accountant for entry in the voucher record.

Some users of the voucher system of book-keeping require the rendering of invoices for material purchased, or for other charges on special voucher forms, which are sent out with each purchasing order. These vouchers sometimes carry the blanks for checking the receipt of goods and the prices, and a table giving the titles of the various ledger accounts for use in designating the



## THE COST OF MATERIAL

charges to be made in entering the transaction on the books. It is unquestionably an inconvenience for the seller to use these special forms, and the receiving memorandum of Fig. 8 is preferable, since it does not require special invoicing.

MAN	210	FOREMAN	W. B.	DATE	12 18	ORDER	1292
QUAN.	24	DESCRIPTION			RATE	AMOUNT	
		1/2 x 3 Mch B					

MAN	210	FOREMAN	W. B.	DATE	12 - 18	ORDER	1292
QUAN.	24	DESCRIPTION			RATE	AMOUNT	
		1/2 x 3 Mch B					

3 x 5 inches

FIG. 11.—MATERIAL TICKET.

White record slip remains in foreman's book. Brown tag-board carbon copy goes to stock-room. Rate and amount filled in on ticket by stock keeper or cost-clerk.

The method of charging out the issues of material for factory work is as follows: For each issue of stock, a material ticket (Fig. 11) is filled out by the foreman, giving the order number to which the material is to be charged, the description of the material, and the quantity required. The ticket is handed to the storekeeper, who issues the goods called for, writes off the amount on the memorandum card on the stock bin, and if the order is for staple product of the factory, checks off the

## COST-KEEPING FOR MANUFACTURING PLANTS

item against the bill of material previously furnished by the superintendent or production department, to prevent careless over-issue and waste. All tickets for materials issued are sent to the cost-keeper at the close of the day's work. On the following day the quantity issued and the factory-order number are entered on the stock-ledger card, the price is entered on the ticket, and the balance on hand is carried forward on the inventory card.

Material items belonging to the class "specials" are usually ordered as required, and upon arrival at the factory, put immediately into work, without any interval of storage in the stock room. In the ordinary course of events, such items would not be charged out on a ticket, because they would reach the foreman in response to his original requisition on which they were ordered, and without further effort on his part. The most convenient way to handle such purchases is to make no difference between them and articles regularly kept in stock, but to charge everything purchased to the material account, whether the articles are actually put in the stock room and taken out again, or merely brought in through the receiving door and sent to the workroom where they are required. These special purchases are usually peculiar, or of large size, or have some other feature which makes it easy to keep track of them, even though they have not been inside the stock room. The stock keeper should himself make out a regular material ticket (Fig. 11) for each such article received and intended for use on a definite shop order, and immediately paint or mark the order

## THE COST OF MATERIAL

number on the article; thus going through the form of receiving the article into the stock room and issuing it therefrom, without actually performing the labor of transportation. There is a possibility that such a material ticket may be duplicated, but the fact is sure to be noticed and corrected. If mistakes must occur, it is safer to have one charge too many than to omit an item of cost, and thereby show a fictitious profit.

Finished parts, already mentioned, are made up for stock as required, by entering production orders for more when the minimum point is reached. They are ordered out and accounted for like unworked material, except that material and labor are both entered on cards like Fig. 10, and charged off separately. The reason for this is that under different factory conditions the same parts might be constructed for stock, or made directly on orders for complete product, and by carrying the cost records separated, the totals for material and labor in complete orders will not be affected. If finished parts were given a lump value, the cost of a certain part might appear sometimes as labor and material, and at other times as material only. Where burden is correctly charged, in the manner explained elsewhere, the burden amount also is carried separately on the finished-part record, making three columns on the card, but adding little to the clerical work.

Some materials, like short pieces of lumber, are practically scrap except where accidentally useful. The full value of such material should be observed and charged

## COST-KEEPING FOR MANUFACTURING PLANTS

up to the cost of the order, but the requisition should be credited to expense in the particular department where it originated. In this way, lumber used on small patterns, for instance, will do its share in diminishing the expense account of the department, and will appear correctly at its full value on the cost-sheet. The actual entry is best made by the cost-clerk as a credit in red ink on the charge sheet belonging to the proper expense order, corresponding to the regular charge to the production order on which the material from scrap was used. Sales of scrap, in small shops, may be similarly handled, a factory order being made out for the transaction, and the net value received for the scrap entered as a credit in red ink on the general-supplies order of the proper department, or on the production order on which the scrap originated.

Material returned for any reason is to be credited to the order for which it was issued, and a proper credit slip sent to the cost-clerk. In the case of defective parts, they should be charged either to "defective material and labor," or where covered by a seller's guarantee, charged to a special factory order issued for the purpose and billed to the seller with a notice that they are held defective, subject to his instructions as to disposition. Finally, parts returned by customers for credit are to be charged back at cost price only, and the stores clerk should see that this is done, the profit already charged on the sale being written off against the proper account in the office, so that the material may stand on the books

## THE COST OF MATERIAL

at its cost price. The credit slip may be the material ticket, Fig. 9, but printed on red paper; or where few credit transactions of this kind occur, the regular material ticket, with a rubber-stamp impression across its face reading "Returned Material."

## CHAPTER VII

### THE COST OF LABOR

THE labor account presents a very different set of conditions from those governing the methods used in connection with the purchase of materials. Materials are weighed, measured, or counted, and paid for at thirty or sixty days, definite sums for definite quantity and quality. Labor is far more difficult to appraise as to either amount or grade. Payment for labor is practically spot cash on delivery, the factory assuming all risks of rejection of bad work by future purchasers, and relieving the workmen of responsibility for their own faulty performances. The human element enters very largely into the labor item. Specifications for materials are expected and followed; but regulations to govern labor are received with hostility and disregarded to whatever extent will be tolerated by the management. The necessary rigidity and exactness of accounting methods must be applied with tact and caution, or labor troubles will diminish profits, and may even prevent the successful operation of the works.

In the majority of factories, labor is paid for at stated intervals and in cash, by the primitive method of handing out the cash to each employee, without check or

## THE COST OF LABOR

receipt. The transaction is purely personal between pay clerk and workers, and being dependent on personal care, disputes rarely arise. It is obvious that pay envelopes could be abstracted by the paymaster to his own advantage, except for the rigid rule that the pay roll is to be made up by some man other than the one who hands out the money. As both men must engage in any attempt to defraud the company, the possibility of theft is slight. It is possible to take the signature of each man, or his mark; or to have some system of checks or tickets, to be delivered in exchange for the pay envelopes; or bank checks may be used instead of currency. The delay in the process of paying off, and the obvious objections to the weekly procession to the nearest saloon which will cash the checks in exchange for a few drinks, leave the old man-to-man system of paying off as the preferred one.

In fixing the price of labor, the relation of employee to employer is that of seller to buyer. The employee and the employer are interested in the bargain from opposite sides. The workman naturally wants to get the greatest possible price for the labor he furnishes, while the employer desires to obtain the greatest amount of work for his expenditure. As a condition of physical and mental comfort for the workman renders him more contented with his situation and wages, and provides for the employer a greater quantity and better quality of work, some of the outlay for labor in the modern factory is devoted to expenditures other than wages.

## COST-KEEPING FOR MANUFACTURING PLANTS

Careful study is given to-day to maintaining comfortable workrooms, with temperature and lighting suited to the character of the work being done, and equipment designed to promote as far as possible the comfort of the workmen. In such places the employees work to better advantage, and with less fatigue, and consequently turn out more and better work. The success of modern shops with ample light and healthful atmosphere has led manufacturers to experiment further, providing what would have been considered a few years ago extravagant luxuries, such as lunch and rest rooms for use during the noon hour, and bathing facilities so that operatives may go out on the streets after working hours in a cleanly condition; also reading rooms, libraries, and opportunities for study and advancement, usually along the lines of factory work, but often on broader lines of general culture. These expenditures have often resulted advantageously, in the efficiency of the operatives, through increasing their knowledge and skill; in the quality and quantity of work turned out by employees well disposed toward the management; and in the number of applications for employment, so that the most expert workers may be selected. However, such liberality has not always been rewarded. In some instances, the provision of unusual conveniences has been taken as evidence that the management was obtaining for itself too large a proportion of the earnings derived from labor, and giving back only a fraction in useless luxuries; so that shops in which the most advanced ideas of comfort for opera-



## THE COST OF LABOR

tives exist have not been exempt from strikes and labor troubles. In spite of such discouragements, it seems to be the present opinion of those best informed, that the limit of profitable expenditure for comfortable working conditions has not been reached.

The amount of work turned out is controlled also by other circumstances than rates of wages and comfort in workrooms. In dealing with human beings of every order, tact is the ruling factor. In countless instances, strikes have occurred against the introduction of obvious improvements, or better facilities, or fairer methods of payment, though self-interest would have kept the men at work, if the fact of their real gain from the improvement had been made clear to them. In the everyday occurrence of a demand for a raise of pay, the despotic superintendent says that he must either accede, or discharge the applicant forthwith to prevent the deliberate waste of time that will follow a refusal. The tactful boss explains the reasons for deferring the increase, and retains the services of a man who feels that his wishes have received consideration. The accountant, like the superintendent and the foreman, should remember that, other things being anywhere near equal, the best workers go to the factory which provides the greatest measure of comfort and the fewest petty annoyances. Whenever changes are to be made in the factory routine, it is well to consider the probable desires of the workers, and prepare to proceed along the line of least resistance in the desired direction.

## COST-KEEPING FOR MANUFACTURING PLANTS

In handling workmen, and particularly in connection with money matters, it is necessary to keep in mind that as a force made up of experts is unobtainable, every employee has both limitations and excellencies. It should not be expected that a willing young man who left school at an early age can select for himself the best railroad train and cheapest route for a long journey. Each workman should be carefully instructed on all necessary points outside of his proper trade. Nine-tenths of the apparent laziness and inefficiency of working people is caused by their lack of understanding of what is required, and of the attitude of their employers. The foreman and superintendent who can most quickly and accurately grasp the points which his workmen cannot comprehend, and who can confine his explanations to these points, will be rewarded by obtaining a remarkably large amount of work from his men, and by making a friend of each one of them.

The management of employees depends for success on common sense rather than printed rules. The human element is the controlling one. Rules and regulations can be enforced only by public opinion of shopmates, fine, or discharge. The first cannot be forced into arbitrary channels. The imposition of fines is possible only after the provision of some charity or benefit scheme into which the penalties can be turned. Discharge of a good workman penalizes the employer as well as the employee, and is a last resort, to be adopted only when the workman is a disturbing element whose elimination is desir-

## THE COST OF LABOR

No. \_\_\_\_\_

Checks \_\_\_\_\_

INFORMATION CARD—The U. S. Manufacturing Company, Lorain Shop

Regular hours of work are week days 6 A. M. to 11 A. M. and 11.45 A. M. to 5 P. M.; except that Saturday afternoon closing time is 3.30 P. M., making a total of 60 hours per week. **Standard time** is used.

Register on the time-recorder at commencement and close of each half-day. No payment will be made for time not correctly registered. Five minutes will be allowed men arriving before 6.05 A. M., if detained by fault of street-car service; in all other cases wages will be paid only from the next even quarter-hour after starting-time as registered.

Wages earned each week are paid the following Saturday. Men leaving this Company's employment will be paid in full immediately, if this card together with all tool-checks (or five cents each for lost checks) and the written order of the General Foreman, is surrendered to the Cashier.

FRONT OF CARD

### THE BEST WAGES

are paid by those shops which turn out good work at the lowest cost and know the exact cost of each machine so as to sell at a moderate profit. Accordingly,

**Material, files, waste and supplies** will be furnished only in exchange for foreman's orders.

**Jigs and tools** will be supplied at the tool-room only in exchange for workmen's checks, one check for each tool. When tools are returned in good order, checks will be given back. Broken tools must be reported to the foreman, who will arrange for the return of the workman's tool-check.

**Time on each job** must be recorded on a separate job-ticket. When stopping work each afternoon, and also whenever commencing a new job, put the job-ticket for the day or work just finished on the time-keeper's desk; he will make out and bring a new card for the next job as soon as possible.

Please keep machines, tools and surroundings clean and in order; don't throw waste or rubbish in dark corners, and **never leave oily rags on the floor.**

BACK OF CARD

3 x 5 inches

FIG. 12.—WORKMAN'S INSTRUCTION CARD.

## COST-KEEPING FOR MANUFACTURING PLANTS

able. The shop routine can be quickly imparted to newcomers by an instruction card like Fig. 12. The necessary regulations will be studied quite as carefully as from printed sheets posted on a wall, while the card is usually preserved for use as a certificate of employment which may assist in obtaining another job in future.

The services rendered by the workmen cannot be measured like commodities; yet they must be valued in some way as a basis for computing wages. The oldest measure of work is the day's labor. In spite of its manifest objections, this unit of measure is still used for much of the work done in factories and elsewhere. Pay is reckoned on time only, without regard to quantity or quality of work done. The only records necessary in connection with the time-pay system are those of the times of commencing and quitting work. Accurate time-keeping systems are required for disciplinary purposes in all factories, even where the pay system has nothing to do with the time worked. Tools and equipment must be kept in continuous operation if the full output is to be obtained, so that pieceworkers as well as dayworkers must be held to regular attendance. For this reason it is best to have but one entrance to the works, or but one entrance to each definite section of the plant, if the ground area is very large; and to require all employees to enter at or before the stated hour of commencing work. A sufficient number of checking points must be provided at each entrance to prevent objectionable delays in entering and leaving, which would occur if a large number

## THE COST OF LABOR

of men were compelled to crowd past a single time-keeping device.

The original method of timekeeping was by personal observation. With time book in hand, the gateman at the entrance of the works noted each man as he passed in or out. To facilitate the operation, and provide for larger numbers of men than could be personally recognized by the timekeeper, the check system was next devised. Each workman is assigned a numbered time check to be deposited at the office when going in or coming out; preferably the latter, since it avoids the likelihood of losing the check outside the works or leaving it at home by carelessness. The timekeeper being only human has friends who are never docked though late; and, however careful he may be, is sure to make some mistakes, and be charged with others which he did not make, the net result being the loss of more or less money paid out for time that was never worked. It should be noted that losses in paying for labor are generally borne by the employer, as each worker takes the best of care that he shall not be defrauded by accident or design, while the employer generally gives the benefit of the doubt to the workman.

Mechanical time-keeping devices have now largely superseded the timekeeper for all work performed in factories or enclosures where permanent time-keeping offices and methods can be installed. The first of these devices, still extensively used, was the Bundy time-recording clock, provided with a numbered key for each employee.



## THE COST OF LABOR

the purpose of arranging the time records of the workmen in the order of their numbers. With a sheet of this kind, each man's entering and leaving time is found in the same straight line, or on the same circle, and the checking of the working hours of all the operatives is very

80	7 28	1.208	1.28	6.06		
79	6 57	1.206	1.257	6.04		
78	6 55	1.204	1.256	6.03		
77	6 54	1.203	1.254	6.02	6.58	9.03
76	6 53	1.201	1.253	6.00	6.55	9.01
75	6 51	1.200	1.251	5.31		

FIG. 14.—DIAL RECORD OF POINTER REGISTER.

much facilitated. To avoid the handling of separate keys, and the occasional loss or theft of one or more of them, time clocks have been made with a series of levers or small handles, one for each number representing a workman, which, being turned or depressed, produce the record; or with a dial and pointer which can be swung to the proper number and there moved and so record the number and time. All these devices produce a marked or punched record on a paper sheet or strip, of which Fig. 14 is typical, and this serves as the time sheet for the day's work.

While human fallibility is eliminated from the clock

## COST-KEEPING FOR MANUFACTURING PLANTS

record, such time sheets are not convenient for showing the workman, in case of dispute, how his time record stands, and how his wages were computed. For the purpose of furnishing each man with a separate and distinct record of his working hours, the card recorder-clock system of the Rochester type, and its later modifications, were devised. The Rochester time clock was provided with a slot or pocket, in which the workman might insert his individual time card (Fig. 15), and print on it, by the pulling of a lever, the present hour and minute. These clocks are now made so as to prevent the insertion of the card upside down or otherwise reversed, and to shift a movable bottom in the card pocket so that the record for each day of the week is made on the proper line corresponding to the day. There is also a lever provided to shift the card pocket sideways so that the entering or leaving time is shown in the proper column. Late entrances, after 7 A.M. or other stated hour for commencing work, or early departures, before the proper time of closing work, may be automatically printed in red figures, which conspicuously display such delinquencies. This simple device for advertising tardiness has proved a valuable means of securing punctuality. The limit to the number of men that can register on a single Bundy key or card clock is set by the total time required for all to register. Two hundred is the maximum allowable where all employees enter and leave at the same hour, and a limit of one hundred is preferable.



## THE COST OF LABOR

While a good time-recording system prevents paying wages to men who are absent, it can do nothing to in-

**FORM NO. 3.**

No 427

Name Wm. Smith

Total Time \_\_\_\_\_ Hrs. Rate \_\_\_\_\_

Total Wages \$ \_\_\_\_\_

Week Ending 12-18 1909

IN	OUT	IN	OUT	IN	OUT
<sup>F</sup> <sub>AM</sub> <u>658</u>	<sup>F</sup> <sub>PM</sub> <u>1201</u>	<sup>F</sup> <sub>PM</sub> <u>1257</u>	<sup>F</sup> <sub>PM</sub> <u>603</u>		

FIG. 15.—CARD FOR RECORDER CLOCK.

sure that the employees use their best efforts to produce work. For this reason numerous pay systems based on other measuring units than those of time have been de-

## COST-KEEPING FOR MANUFACTURING PLANTS

vised. The simplest of these is the piecework plan, by which quantity of work is paid for instead of hours worked. The incentive for speed on the part of the workmen is increased, as his wages depend directly upon the quantity of work he turns out; but with increased speed comes the tendency to slight the work. Accurate gauging and inspecting systems are absolutely necessary with every form of piecework pay system, for employees cannot be expected to look after interests diametrically opposed to their own. But the most common trouble with piecework systems comes from the increased facility of the workman which the system is intended to produce; for increased skill invariably results in the eventual production of so large a quantity of work that the day's earnings will become much higher than the current rate demanded by men of similar ability employed on other work. This condition does not at first seem objectionable, as the employer is realizing from his machines and equipment an increased amount of work, directly proportional to the amount paid in wages. His competitors, however, taking advantage of the experience gained, can start their men at a lower rate per piece, and turn out work at lower cost. It is therefore inevitable that excessive increase in the earnings of pieceworkers must result in the cutting of the piece rates. This possibility is so well recognized that limits are set by the pieceworkers to the amount of work that they will do per day. Each man increases his output until his day's earnings are as large as he thinks his em-

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ployer will stand, and will do no more, even though he must spoil work or cause "accidents" in order to keep down his output.

The obvious course to follow in order to get the greatest possible product by piecework is to guard against excessive earnings by making a very careful preliminary study of the amount of work that can be done in a day, and setting the piece rate accordingly. Experience proves, however, that there is rarely a fixed limit, and that it is only a question of time when the most carefully set piece rate will prove to be too high, that is, higher than it would be necessary to pay to induce other workers to perform the task. Rates have been sometimes amicably readjusted in consultation with the pieceworkers; or set to hold for a certain definite time, as a year. However the adjustments are made, it is a foregone conclusion that the pieceworkers will not afterwards use their best efforts and bring about another cut.

Endeavoring to avoid the difficulty caused by cutting rates when they are found to give an unnecessarily high return, and to protect the compensation of the workman who is successful in devising methods of increasing his production, Mr. F. A. Halsey devised what he named the "premium" system. In this system the workman is given a fixed task, measured in a quantity of work to be performed in a given time, or for a given sum of money, and the benefit from any improvement in working time is divided between the employer and the em-

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ployee. Thus, if the set work is ten pieces to be finished in ten hours, and these ten pieces are finished in nine hours, one half of the time saved is paid for by the employer, the workman therefore receiving regular wages for an extra half hour, and still having the full hour saved in which to earn wages on the next job assigned to him. The shares of employer and employee may be varied to suit conditions. The net result of the premium plan is the paying of the workman a less amount per piece than he would receive by straight piecework; so that it has been construed by some workers as a scheme for robbing them of part of their just earnings. The incentive for increased work is therefore less than with straight piecework. If by his efforts the workman can cut his time in two, producing the set day's work in half a day, he receives only three fourths of a day's pay in return for what was formerly a day's work. One of the advantages of piecework is the increased speed of the workman, not only by his saving of wasted minutes, but also by his diligently studying to increase his speed while at work. Any scheme which tends to weaken the incentive makes it probable that the workman will not reach the possible maximum of production, and that the employer's interests will suffer accordingly.

A beneficial selection of the best workers results from both piece and premium plans. The expert workers will make large wages on piecework which will not afford the incompetent man a fair day's pay. Quick workers are more desirable for the factory than slow ones, since

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they turn out more work with their machines, and increase the factory output. To get rid of the slow workers and attract the quick ones, Mr. F. W. Taylor some years ago devised what he named the "differential" 17  
piece-rate system. He paid the quickest and best workman a high piece rate, making his day's work net him an unusually high wage, while less efficient workmen, not able to reach a certain assigned quantity of work per day, were paid a much lower piece rate, resulting in a day's wage so unsatisfactory as to send them after easier jobs in other plants. In this way Mr. Taylor was able to attract a superior force of workmen, and to produce remarkable results.

A fourth system, perhaps the newest at the present time, is that of Mr. H. L. Gantt, named by him the "bonus" 18  
system. A definite day's work being set, based on a very careful study of the capacity of the tools under the most favorable conditions and with the quickest possible handling of work, the workman is instructed in the various steps of the process, informed how much he will produce by following these instructions, and offered a satisfactory bonus in addition to his day's wages if he reaches the intended output. Inefficiency or carelessness resulting in the production of less than the specified quantity of work causes the workman to lose the bonus, and leaves him, as with Mr. Taylor's differential piece rate, the stimulus of an insufficient wage to induce him to do better next day, or to make room for a more efficient man. The bonus system lacks incentive to the

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workman to try to do more than the specified day's work; but the theory is that the task shall be so carefully studied in advance that the set day's work shall be the utmost attainable with the materials and facilities provided.

A comparison of the five methods of paying labor which have been briefly described shows that each has advantages and disadvantages. Not one is ideal under all conditions. It cannot be expected that the ordinary run of operatives will usually give hard, conscientious service for day pay, so that the amount of work which is produced depends very largely upon the success of the foreman in controlling his men, in interesting each in the quantity and quality of his work, and in driving those who tend to fall behind from laziness, or to spoil work. The piecework system provides a strong incentive to haste and corresponding carelessness; while the effect of cutting rates which have reached high figures by increased efficiency is demoralizing, except where the work is of such a nature that other men may be readily trained to take the places of those who leave from dissatisfaction with reduced rates. The premium system gives less incentive than piecework, but at the same time reduces the loss of the employer through excessively high wages as workmen become more proficient. It is less easily understood by workmen, and here also loses incentive, as men not proficient in figures do not realize their gains from increased efforts as well as when their wages are calculated by simple multiplication. The differential system depends for success, even more than

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simple piecework, upon the careful setting of the day's task at which the division between the higher and lower piece rates is made. The bonus system eliminates the incentive of increased pay for increased effort, and considers the workman as a mere part of a machine, incapable of assisting in planning or improving the methods.

Every one of the piece systems requires special inspection of work to maintain its quality, and a special planning department to study the conditions under which the work is done, and to compute the rate which shall be paid. For factories where the nature of the work varies, and where it is important to lose no time between the placing of the order and the commencing of work, piece-rate systems are difficult of application. Any necessity for haste in fixing rates induces careless guessing, resulting in prices either too low or too high, and both conditions are demoralizing to the workmen, whose wages vary greatly through no fault or credit of their own. The time system is therefore universal in jobbing work. The various forms of piecework payment are best suited to manufacturing establishments where repetition work is carried on, and have their greatest success in factory operation involving the production of very large lots produced by special methods developed by careful study.

There is yet a small and special class of workmen employed outside of shops on such work as erecting or general repairs who cannot be supervised and paid by any of the systems described. These men work without

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direct supervision, and are usually selected for reliability and initiative, so that they may be depended upon for effective attention to their employer's interests. They frequently hire and pay their own helpers, purchase supplies and materials, receive or ship goods, and deal with transportation companies, and handle heavy work with limited facilities. Most important of all, they must represent their employers with credit, combining the differing functions of constructors and business agents.

Erecting men are almost invariably paid by weekly or monthly salaries, rarely by fixed day wages. Payment by the hour is objectionable, as a man away from home and family, and having no local interests, is almost sure to put in unusually long working hours, to the possible detriment of his own health, but to the certain decrease of his rate of work as he becomes overtired and loses interest. Men sent away from the shop to erect machinery or do extended jobs of outside work should be instructed in advance that they will have more or less spare time due to delays and causes beyond their control. They are expected to work the regular shop hours, putting in overtime when necessary to cope with emergencies, and to expedite work, but taking corresponding rest or holidays when the opportunity affords. Erecting men receive certain compensations, in the way of travel and prestige, which they value in addition to their wages, and which assist in obtaining good men for the work.

The work of men employed outside of the shop and away from the direct supervision of the management





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can be controlled and guided only by close attention to a system of daily reports. The erecting man is supplied with blanks like Figs. 16 and 17. The first is the weekly time and expense report, and is to be filled out and mailed to the office on Saturday afternoon of each week. Workmen employed locally outside of the factory use a simpler form, the outside time card or job ticket (Fig. 18), which is to be signed by a representative of the person or corporation for whom the work is being done, as a condition precedent to the payment of the workman's wages. Erecting men are required to send in complete daily reports of their work on the special letter sheets (Fig. 17). These reports show the progress of the work, keep the administration informed of any difficulties or delays, so that the interests of the employer may be defended, and protect the factory by written evidence, against unfair complaints made after the workman has returned home, possibly after he has left the employ of the works, such as complaints that the work was not well done, or that the number of days charged were not actually worked.

When his job is completed, the outside man must obtain a written approval of his work from the customer. The erecting man generally has little trouble in getting such an approval signed, since he has been doing his best to satisfy all parties, and is in a position to ask for what is in effect nothing more than a testimonial to his attention and energy. The written approval is a powerful deterrent against future trivial complaints.

# ERECTOR'S DAILY REPORT

Order No. 1220

TO  
UNITED STATES MANUFACTURING COMPANY, NEW YORK CITY

Dated at Monmouth 12-17-1909

Write all your  
orders to us on  
these sheets

Give on this  
report

(1) SMOST  
DESCRIP-  
TION OF  
WORK DONE  
THIS DAY.

(2) Cause of de-  
lay, if anything  
on your fault  
has prevented  
our satisfac-  
tory progress  
this day.

(3) Statement  
of work you ex-  
pect to do to-  
morrow, and  
probable time  
of completion  
of whole job.

(4) Articles  
expedited from  
us and not re-  
ceived, whether  
previously re-  
ported or not.

(5) Articles re-  
ceived this day  
and from whom

Weather so bad we could not unload car of columns.  
There is enough at the building to keep them long for  
a while. We need those brackets I wrote for Tuesday.  
Send bag of rivets for brackets and 2 - 1/2" drills.  
I have plenty of help ready as soon as weather moderates  
and think we can finish by the 30th.

*Jones*

8 1/2 x 11 inches

FIG. 17.—ERECTOR'S DAILY LETTER.

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The forms already shown provide for recording the total time worked, but (except Fig. 17) do not show what kind of work was done. There is required a second set of records, called "job tickets," to supply this very necessary information. Several forms of these are given

41 <small>MAN</small>	Pipe <small>TRADE</small>	2-14 <small>DATE</small>	1540 <small>ORDER</small>	
<small>RATE</small>	1 3/4 <small>HOURS</small>	9.30 <small>COMMENCED</small>		
		11.15 <small>STOPPED</small>	L	B
<small>WHAT DOING</small>	Connecting water line			
<small>TIME CORRECT</small>	Holmes Hotel			
<small>SEE OTHER SIDE FOR HOUR OF MAN'S LEAVING SHOP</small>		PER WBR		

3 x 5 inches

FIG. 18.—OUTSIDE JOB TICKET.

by Figs. 18 to 21 inclusive. In some factories these tickets are filled out by the workmen, ostensibly when their machines do not require manual attention. As this desirable ideal is probably seldom realized, and productive labor should not be diverted to clerical work, other factories employ timekeepers to make rounds two or more times per day and record the time and description of work of each employee. But the best and most desirable method in every way is for the foreman to use the job tickets as his orders to the men. This is the most

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modern practice, in line with the advice of successful organizers of factory system. The foreman, or in some cases a regular planning department, lays out the work well in advance of its execution, deciding the order of the several operations, and the number to be done to-

127 <small>MAN</small>	42 <small>TOOL</small>	2/9 <small>DATE</small>	1638 <small>ORDER</small>
25 <small>RATE</small>	3½ <small>HOURS</small>	o <small>R</small> ✓	 <small>L</small> <small>B</small>
12 <small>PCS.</small>	Rod ends <small>DESCRIPTION</small>		
 <small>WHAT DOING</small>	Drilling eyes		

3 x 5 inches

FIG. 19.—JOB TICKET.

gether as a single "job." The tickets are then filled out in advance and placed in racks ready for the workmen. As soon as a workman finishes his job, he brings the accompanying job ticket to the desk, writes or stamps the time of completion, and drops the card in a box. He then takes the next card from his pigeonhole in the foreman's rack, stamps the time of commencement, and proceeds with the job as the card directs. Unprogressive foremen used to old methods sometimes find the planning of work in advance irksome. Where regular manufacturing methods can be adopted, planning work in advance,

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if fairly tried, will be found a great relief from the constant anxiety of "snap judgment."

Of the forms shown, Fig. 18 corresponds with Fig. 19, both being the simplest form of job ticket, the latter for work inside the factory, the former for outside work.

	COMM.	FIN.	PIECES.	Hrs. Reg. Over T.			
Su.						MAN NO	127 ORDER NO 1638
Mo.						TOOL NO.	42 DR. NO A-1441
Tu.						PARTS IN LOT	12 <i>Red Gumbo</i>
We.	7	10:30	12	3½		WHAT DOING	<i>Drilling eyes</i>
Th.							
Fr.							
Sa.						F-NF	
Total Hours Regular Time.....				3½		Rate Reg.	Cost
Actual Hours Overtime.....						Rate Over	Cost
Total Pcs. and Hours						Rate Burd.	Cost
Week End'g	2-12					Cost Each	Total

3 x 5 inches

FIG. 20.—JOB TICKET WITH DAYS OF WEEK.

These tickets are shown filled out, as they will be sent to the foreman for his approval before being forwarded to the cost-keeper. Fig. 20 is a job-ticket form carrying spaces for each day in the week. The commencing and finishing time, and number of pieces worked on, with the hours of regular and overtime work, are filled in on the line corresponding to the proper day. This ticket can be used either for one day only, or for the entire duration of the job, though it be several days, except as follows: Where, as in jobbing machine shops, assignments

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are short and tasks are soon completed, job tickets should terminate at closing time of each day, and new tickets should be issued next morning at the starting hour. But with factory work where employees are

Employee's No.	Job No. <u>530</u> Part No. <u>B-14</u> Date <u>3-17-06</u>	
	For <u>12 x 12 Eng.</u>	
	Part <u>Butts</u>	
	Operation <u>Milling</u>	
	STOPPED	= 4 98
	STARTED	= 5 98
	TOTAL TIME	
	Quantity Started <u>40</u>	
Quantity Finished <u>38</u>		
No. Spoiled <u>2</u> Reason <u>Bad castings</u>		
<u>WFB</u> Foreman.		

3 x 5 inches

FIG. 21.—JOB TICKET FOR DEY TIME CLOCK.

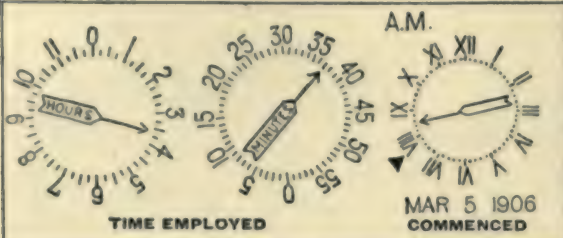
Time printed in hours and hundredths.

steadily occupied for days together on the same job, the weekly card may be preferred. In either case, the termination of all tickets at the set time provides an opportunity for checking the total of times or jobs reported with the total of hours or wages shown by the time-clerk's record and the pay-roll. When a card is turned in at closing time, or with the weekly card, closing time Saturday afternoon, the letters F or NF are canceled to show whether the job is "finished" or "not finished."

Factory employees cannot be depended upon for an

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accurate record of their time on each job. Where jobs are short and variable, and where premium or bonus methods of payment are in use, a clock record, always very desirable, becomes indispensable. Fig. 21 is a job

					Job No. <b>530</b> <b>MACHINE SHOP</b> Workman No. <b>38</b>
Boring	Drilling	Grinding	Planing	Tapping	Time Allowed
Chipping	Facing	Milling <input checked="" type="checkbox"/>	Roughing	Threading	Premium Credit
Cutting Off	Filing	Mounting	Shaping	Turning	Foreman
Quantity <b>40</b> Total Time <b>2</b> Rate _____    Cost _____					

*3 x 5 inches*

FIG. 22.—JOB TICKET FOR CALCULAGRAPH.

The two left-hand dial impressions show respectively hours and minutes of elapsed time since the right-hand dial impression was made.

ticket used with the Dey time-recording clock. The essential features of the card are similar to others shown. Fig. 22 shows the form used with the Calculagraph, a clock device which prints elapsed time, and reduces the computation of wages to a mere multiplication, or a reference to a printed wages-table.

Job tickets are sometimes printed with the names of all the usual operations performed in the factory, so that a simple check-mark suffices to indicate the kind of work done. In machine shops there are so many possible kinds



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of work that the card becomes complicated; but in many other factories, where work can be classified into fewer groups, the system is very satisfactory by reason of the uniformity it affords. Piecework is recorded on job tickets like daywork; but the tickets should be stamped or punched, or printed on colored cardboard, to differentiate them from the manila tag board used for whichever kind of job tickets are most numerous in the factory. Men on piecework must record their time on job tickets, so that all time may be accounted for. Piecework tickets are treated by the cost-clerk as representing absence and no wages as far as the time pay-roll is concerned, and are placed together until the piecework task is finished, and then passed for payment and the amount entered on the pay-roll of the day on which the work was completed, inspected, and passed. Premium tickets are similarly treated, but the day pay is allowed as the tickets come in, and the premium is computed and entered when the job is finished.

The whole job-ticket system has the convenience of being a system of original detailed records. Every fraction of the day's work of each man has its own separate ticket. All items paid for through the pay roll must necessarily be charged upon the cost-sheets, so that there is always an exact accountants' balance between pay roll and cost-sheets. If the tickets are used as they should be, as the foremen's orders to the men, the labor of making them out is compensated by the advantage of definite, exact written instructions, instead of easily forgotten

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oral advice. Piecework or time-pay records on similar jobs can be filed together and compared at any time. A properly filed series of job tickets covering a period of several years is an invaluable asset in modern scientific factory management and cost-reduction.

## CHAPTER VIII

### THE COST OF THE "SUNDRIES"

IN the accounting of any large manufacturing business, many items appear which are neither material nor labor, and yet are directly traceable to specific items of factory product. Some accountants make no provision for such items, and charge them to one or the other of the appropriate accounts under the head of general expenses. But while many miscellaneous expenditures have no direct relation to any one part of the factory product rather than to any other part, there are some invoices and charges which should not fairly be charged against the cost of all, as is done by carrying them in the general expense account. Whether these items are sufficient in number and magnitude to justify special treatment as direct charges, is for the accountant to decide. If his verdict is in the affirmative, and yet the items are likely to be few in number, he can charge them in with the material account and credit them out again accordingly. If he considers that more precise methods are warranted, he will adopt the method of carrying a third series of cost items—the "Sundries" account.

To the "Sundries" account is to be charged all bills from outsiders which do not represent material delivered

## COST-KEEPING FOR MANUFACTURING PLANTS

to the works, or transportation charges on such material from its place of origin. The use of the term "sundries" must not be taken to sanction the indiscriminate charging of all sorts of items to the account so entitled. It must carry only such charges as represent neither material nor factory labor. Among these are expenses for inspection of articles or processes at other shops; railroad fares for purposes directly connected with individual factory orders, as, for instance, the tracing of freight on large and important work; miscellaneous freight and cartage charges which are not connected with the original delivery of material to the works, or which could not readily be added to the original cost of the material; inspections, tests, or assistance rendered by outside parties; supplies consumed in carrying out the particular work, as fuel, oil and grease in quantities; special commissions or expenses; and extra items which would make it difficult to compare the costs with other work done to standard specifications.

In factory cost-keeping the sundry charges are the most elusive of all expenses incurred in doing work. Not being represented by actual deliveries of material, they are likely to be overlooked and omitted from the summary of cost items, and discovered only after the cost has been made up and the selling price or profit computed and charged. For this reason it is necessary for the accountant to hold strictly to the rule that every person giving instructions for work which may result in a charge to sundries, shall send a requisition to the purchasing

## THE COST OF THE "SUNDRIES"

department, giving the factory-order number to which the charge is to be made, so that a confirming order may be sent, and the invoice looked for and entered on the cost-sheet.

Freight, express, and cartage are sometimes necessarily charged as "sundries" to direct cost, instead of going in with the cost of material. In general, delivery charges are added to the cost of material in stock, so as to make the charging price represent the full value of the articles delivered to the workman in the factory. Transportation and cartage charges are sometimes delayed until after the material has been used up and charged, or several lots may be received in a single shipment in such a way that the cost of transportation cannot be apportioned, or material purchased "less freight" may be ordered by express, or in "less-than-carload" lot, with the result of obscuring the real cost of transportation. In such cases it is most convenient to treat the transportation charges as sundries and enter them direct to the cost of the factory order most affected.

Sundry charges are particularly numerous in the orders covering factory expense; gas, electric current, and telephone service are examples. These and other services and supplies are furnished under standing contracts rather than on separate purchase orders, and are therefore more difficult to check as to quantity received and amounts due in payment for them. In dealing with charges for monthly service the accountant cannot be too careful. The previous charge for similar service should

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invariably be compared with the present bill, to see that the rate of consumption by the factory and the price for the service correspond with the known circumstances. Quantities and prices should be reduced to a daily or weekly basis, and compared with previous figures for the same interval. Gas or electric service charges should be scrutinized with regard to the temperature, weather conditions, hours of light, amount of work in hand, and other factors existing during the period under consideration, and which may have affected the rate of consumption. Meters may become incorrect, or errors may be made in weights; or the rate of consumption may increase, as by leakage of water. Such changes are apparent to the alert cost-accountant through the resulting variations in monthly expense bills. Timely notice to the management of unexplained increases in bills for regular supplies may prevent the continuance of serious loss.

As each expense order is totaled monthly, it is important that "sundries" charges be entered in the period to which they belong. If they cannot be invoiced in time for entry before closing the cost-record, the item should be approximated in some way, and entered against a corresponding credit to the account "Sundries." Such credits will be canceled later, when the bills come in. Fuel is an instance of a sundry charge which it is difficult but important to keep correctly apportioned in a given period. The shipment of ten carloads of coal in a single month, while the rate of consumption may be four car-

## THE COST OF THE "SUNDRIES"

loads, will make the fuel account excessive for that particular month. This should be prevented by keeping a daily check with tolerable accuracy on the coal actually fired, and charging to the account of "Power, Heat, and Light" only the cost of that quantity of fuel, leaving the balance charged to "Sundries." These checks may be kept, if better means cannot be afforded, by piling each received lot separately, and reporting the date of using the last of each pile. The cost-keeper can then compute the value of the amount used, charging it to the expense order and crediting "Sundries" accordingly.

The "Sundries" account affords the only means of correctly charging miscellaneous items, not material or labor. The provision of the heading leaves the material account free from items that cannot appear on an inventory, and permits the labor account to balance periodically with the labor cost of factory work. In some kinds of manufacturing, the sundries account, like the other two, may branch into several subdivisions; but always the rule should be to keep the material and labor columns free from items that are neither, and employ a special account for the items that cannot be weighed, measured, or timed by a clock.

The "Sundries" account is kept uniformly with "Material and Labor," by the ticket system. The "Sundries" ticket (Fig. 23) is printed on heavy pink paper. One of these tickets is filled out for each item. The same form serves for a cash slip, by which each expenditure of

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cash for postage stamps, messenger service, express charges, and similar petty cash transactions has its separate voucher in the shape of a pink ticket. Transactions involving "Sundries" which may be carried out

<b>MAN</b> 127	<b>DATE</b> 2-9-1910	<b>ORDER</b> 1484
<b>EXPENSE FOR</b> <i>Carfare, phone &amp; boy</i>		65
<b>SIGNED</b> <i>Mell</i>	<b>TOTAL</b>	

3 x 5 inches

FIG. 23.—"SUNDRIES" TICKET.

through "Accounts Payable," by vouchers or voucher checks, and are chargeable to factory orders, are charged in the general journal to "Material" or "Sundries," whichever method is used, and reported to the cost-keeper by pink "Sundries" tickets. Cash expenditures are entered on the same form, charged as a single daily item to "Sundries," and the tickets chargeable to factory orders are sent to the cost-clerk for entry. "Sundries" tickets representing cash payments belonging to office expense or any other account which is not in the cost-department are treated as simple memoranda, and



## THE COST OF THE "SUNDRIES"

totalled and charged daily, or at any other convenient interval, to the proper general accounts.

Every "Sundries" item has therefore its own proper ticket, so that the account is balanced at each accounting period against the "Sundries" division" of the factory-order costs. If there is at any even period a balance in "Sundries" not charged off, it should be investigated, and the values represented should be identified, so that no undistributed expense may be permitted to accumulate in this division of the factory expenditures.

## CHAPTER IX

### THE CLASSIFICATION OF NONPRODUCTIVE EXPENSE

ONE principle of factory work, as distinguished from production by isolated workers, is the employment of two forces of men—one to produce salable goods, and the other to facilitate the work of the first. The wages paid to the productive workers are charged against the costs of the several factory orders for parts or completed goods. The wages paid to the men who, for want of a better term, are called "nonproducers," are charged to a set of accounts under the general head of "Expense." The accountant, as distinguished from the mere book-keeper, finds one of his most important tasks in the determination of the line between productive or direct cost, and nonproductive or indirect expense; and in so classifying the latter under convenient subdivisions as to make it easy to compare the expense accounts of period with period, and of factory with factory. Comparisons of this nature are so important to successful works management that special conventions of the men in charge of the accounts of corporations engaged in the same business, have formulated uniform accounting systems for their respective lines. Railroads, gas works, and electric companies are among those which have adopted such standard accounting forms. By following

## NONPRODUCTIVE EXPENSE

the prescribed method, the ratios of each item of expense to the items of production may be compared by the accountant, and the strong and weak points of the management of each corporation may be shown and studied.

Factory operations are of such an enormously diversified nature that no standard scheme of cost-accounting such as is used by the gas companies, for instance, has yet been devised to cover all needs. There are, however, general classifications which apply alike to all factory operation, and which are usually recognized by factory accountants. These afford a basis for a system of accounts which provide facilities for comparison, as well as serving to guide the internal management of the works. In the factory proper, expenditures fall naturally into the three classes, Improvements, Repairs, and Expense. In the office, the expenses of administration are similar in all forms of mercantile business, and the customary titles of accounts are employed; while the sales department forms a division by itself. Selecting from the detailed accounts most often employed in factories those which appear most natural and important, the following system of expense is developed:

### IN THE FACTORY:

<i>Improvements:</i>	SHOP SYMBOL
To Buildings .....	IB
To Machinery .....	IM
To Small Tools .....	IST
To Fixtures and Miscellaneous Equipment.	IF
To Power Plant, Pipes, Wires, etc.....	IP

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<i>Repairs:</i>	SHOP SYMBOL
To Buildings .....	RB
To Machinery .....	RM
To Small Tools .....	RST
To Fixtures and Miscellaneous Equipment.	RF
To Power Plant, Pipes, Wires, etc.....	RP

<i>Expense:</i>	
For Power, Heat, and Light .....	PHL
For Foremen .....	FM
For General Labor and Supplies.....	GLS
For Watchmen .....	WM
For Teamsters and Trucking .....	"Stable"
For Defective Material and Labor, and loss by errors .....	DML
For Lost Time, paid for but not worked...	LT
For Experimental Work .....	Exper.

### IN THE OFFICE:

- Salaries
- Office Expense
- Fire Insurance
- Taxes
- Interest and Discount
- Accidents and Liability Insurance
- Royalties
- Legal Services
- Reclamation.

### IN THE SALES DEPARTMENT:

Advertising .....	A
Traveling and Expense .....	B
Salaries and Commissions .....	C

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These divisions and subheads accord generally with the practice of skilled cost-accountants, as represented by their work in existing factories. They may be further divided for the purposes of large works; but it is better to avoid changing the lines of demarcation between them, as by splitting two of the accounts into three made up of parts of the two. Where factory accounts have been well kept, it will usually be found possible to introduce the above series to follow after the old series, the former accounts being divided or combined to agree with the new titles. In small factories, some of these accounts may be grouped and their number thereby reduced to advantage.

In the factory series, symbols have been given to the accounts, formed by suggestive combinations of initials. It may be objected that such mnemonic methods are out of date, and that the Dewey decimal system of classification should be used. The reply is that the symbols of these accounts are to be put on material and job tickets and freely used by the factory workers, many of whom are of limited intelligence and have untrained memories. As workmen and even cost-clerks are coming and going continually, ease of memorizing the system is more important than theoretic excellence of classification. Further, most errors in the letter symbols given are obvious, and are corrected in posting the tickets; whereas a transposed or altered figure is a blind error, likely to escape notice. The numbers of the factory orders are always at hand on the order sheet, and on drawings, instructions,

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and all other data; but the expense work is done by routine, without written instructions, and often under conditions by which no foreman is near to supply numbers upon request. In very large works, where separate shops or separate plants are to be compared, the more comprehensive decimal system may be preferable, but it implies more supervision, and more expense for cost-keeping.

Taking up the several titles as they occur, the first general division, "Improvements," with its five subheads, is placed in the schedule for the purpose of allowing the disbursements for new equipment to be kept separate and charged to capital account, as possessing earning power which will increase the returns from the shop work. It is desirable that charges to capital should consist of important items only, and each must be a real addition to the income-earning equipment, and not a mere replacement of something worn out. Only items greater than some assigned minimum, say fifty dollars in small shops, and much larger designated sums in factories of magnitude, are charged to "Improvements." The small betterments which are carried on in the ordinary progress of events are treated as "Repairs."

The next general division, "Repairs," is subdivided similarly. Repairs to buildings and permanent fixtures are likely to come in irregular amounts, as when a roof covering gives out after some years' service and must be replaced all at once. For this reason expenditures for repairs can be compared only by averaging the outlay for

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a number of months in successive periods. In case the factory stands upon leased ground, the total value of the buildings must be earned before the expiration of the lease transfers possession to the owner of the land; so that in such cases it is strictly proper to charge all improvements to buildings to "Repairs," and not to "Improvements."

"Repairs to Machinery" should include work on all special attachments to individual machines, but not work on tools used interchangeably on several machines. If this rule is followed, the value of the machinery will be kept separate from the value of the interchangeable accessories, and fluctuation in the apparent value of a machine in successive inventories, by reason of accidental changes in location of accessories, will be avoided. "Repairs to Machinery," however, should not include articles such as emery wheels, which rapidly wear out in service; as these, if charged as repairs to the particular grinders on which they are used, would soon make the expense of repairs to the machine unreasonably great. All such perishable articles, blades used for power saws, files for filing machines, and the like, are therefore kept out of the account of "Repairs to Machinery." To facilitate examination of the repair account, each machine should be permanently marked with a serial number, to be stated on all cost-records of repairs or alterations to the machines.

Under "Repairs to Small Tools" is carried the entire expense connected with the small-tool outfit of the shop.

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This includes wages of caretakers in the tool room, cost of steel and other materials for repairing and replacing tools, and all small tools and machine parts which wear out rapidly in service. Special tools made for particular jobs are charged direct to the cost of the factory order, unless it is reasonably certain that they will be useful on other jobs, in which case they may be charged either to "Improvements" or "Repairs," according to the circumstances. Perishable tools such as scrapers and files are not charged to the small-tool account, but treated as supplies. The line here must be somewhat finely drawn, but its location depends upon the intrinsic value of the tool in comparison with the annual expense of keeping it in service by repair or replacement. Articles which are expected to wear out quickly and are not repaired by the shop force are best treated as "Supplies."

The account of "Repairs to Fixtures and Miscellaneous Equipment" is required for such articles as benches, telephones, and other items which are neither machines, small tools, or supplies. In general, fixtures are of small value as assets, and the expense of their upkeep is high in proportion to their first cost, while their depreciation is rapid. In large works, it is wise to subdivide this account, even though these subdivisions are grouped under a common footing in the periodical reports. "Repairs to Power Plant" is a useful account for large factories. It comprises all work repairing pipes, power and lighting circuits, motors, shafting and belts, and accessories.

The division "Expense" comprises first the important



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subdivision of "Power, Heat, and Light." Under this are charged the cost of fuel and power-plant supplies, and the wages of engineers, foremen, oilers, and attendants whose duty it is to keep in order the power-developing and transmitting apparatus. In factories operated by steam power, the exhaust steam from the engines should be used for heating purposes, since otherwise some nine tenths of the heat in the steam furnished by the boiler would go to waste. In weather sufficiently cold to require all the exhaust steam furnished by the power plant, the purchase of power from the outside would save only one tenth of the fuel bill. If the supply of exhaust steam is insufficient, additional steam engines can produce power, while furnishing the extra exhaust steam required, for little more than the cost of fuel for furnishing the heat alone.

It is important to watch for variations in the cost of power. Coal and other supplies are usually delivered in such quantities that the fuel cost for a given month cannot be accurately obtained from the bill rendered. It is best, therefore, to arrange to ascertain each month the approximate amount of each remaining on hand. In small plants, the fireman has time to weigh every barrow of coal brought into the boiler room. If great precision is thought unnecessary, marks at proper heights on the walls of the coal bin will serve as a guide to the amount of coal consumed; or each carload of coal received may be piled separately, and the exact date to which it lasts may be noted. In very large plants, the value of the

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results desired makes it worth while to use accurate methods. The power output should properly be metered, but this is difficult, except where the plant is electrically driven. Fair results can be obtained with a steam plant by measuring indicator cards taken on certain days and under known conditions, and keeping a log in the engine room showing the times of starting and stopping the engines, and the approximate loads under which they are known by previous observation and measurement to be operating. Accuracy, always desirable, is in some cases worth any price. The amount expended for power, while small in comparison with the total running expense of the factory, is nevertheless large enough to make it well worth while to watch carefully the cost of power, heat, and light.

The account "Foremen" covers the wages paid to all men who direct others in performing their tasks, but whose work is of so general a character as to be impossible of direct assignment to separate shop orders. Some shops require their foremen to distribute their wages over the several jobs going through, a practice which makes impossible any proper comparison between the costs of successive jobs. No foreman making good use of his time is able to sum up the odd moments spent here and there so as to account for his day's work with even tolerable accuracy. For this reason all amounts paid for supervision of workers, by foremen or men temporarily acting as such, are charged to the account "Foremen." If, however, an order of special importance monopolizes

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the foreman's time so as to make it desirable to charge his wages direct to the cost of the order, the amount so charged may be credited to "FM," thus reducing the expense account and the "burden."

Recent practice in machine shops tends to decrease the number of employees assigned to a single foreman, and to increase correspondingly the attention and advice which the foreman gives to each man. The foreman should supervise his men continually and closely, not primarily to enforce good behavior, or compel speed, but to devise and put into use the best methods of doing the work. The foreman should deliver to the workman the necessary materials and instructions for his next job before the present one is finished. Some factories provide standardized instructions for each job, specifying the manner of holding the material, the speed of the machine, and the time which will be required for the machine to get through the work; so that to secure the maximum output the workman need only obey the instructions.

The account of "General Labor and Supplies" carries the portion of the wages of the helpers and miscellaneous employees and the cost of factory supplies not readily assignable to specific factory orders. These employees, like those doing productive work, are required to account for their time, charging any extended periods of work to the appropriate shop orders, and the remaining unassignable time to GLS. Subheads such as watchmen, yardmen, and casting cleaners can be used if desired.

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To this account is also charged all work not otherwise provided for, such as the construction of temporary fixtures not properly repairs to buildings or equipment, the handling of scrap, or the shifting of material as required. But any extended period of work on a single "odd job," as, for instance, shoveling after a heavy snowfall, should be described on a separate job ticket, so that any unusual increase in the monthly expense for general labor may be traced to its source. This account also carries the miscellaneous supplies, such as waste, files, grinding wheels, sandpaper, glue, chalk, paint, nails, screws, box straps, and articles used in amounts too small to charge direct to the costs of factory orders. The amounts received from sales of small lots of scrap may be credited to this account, with the value of articles salvaged from scrap, such as pieces of board from the wood box worked into useful patterns, or scrap material which comes in handy for odd jobs, and therefore acquires a value. By following this course the true cost, as it would stand if the accidental supply were non-existent, appears on the books.

The account "Defective Material and Labor" is to carry loss in the factory due to defective material and workmanship. Such losses should not be charged against the jobs on which they occur, unless these jobs are of a nature which renders such losses peculiarly likely. For instance, a shop producing brass castings should include in the cost of making unusually difficult pieces the expense of replacing defective castings. If, however, the

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whole product were castings of average difficulty, it would be inaccurate to charge an accidental loss, as by carelessness of a new molder, to the cost of the particular lot on which the loss happened to occur. Proper cost-keeping does not load the effect of occasional misfortunes upon single orders, but spreads the expense of mishances as a light tax over the whole product, just as the cost of fire insurance is shared by the owners whose property does not burn. The same reasoning applies to accidental faults of workmanship. Wherever defects occur which are not especially connected with the nature of the work, so that it is a mere chance that they fall on one order rather than on another, the cost of replacement or correction should be charged to the account of "Defective Material and Labor." The charge should be for the net loss only; for instance, spoiled pieces should be charged at the difference between their scrap value and their value at the time they were spoiled. Subdivisions of the account are made in some factories, to separate loss by unavoidable defects or accidents from loss by errors of employees. In general, this seems unnecessary, as the end is better served by making it a rule to submit to the manager a special report of each loss or error of magnitude. The variation of the total from period to period is to a certain extent an indication of the efficiency of the factory superintendence.

The account "Lost Time" is provided to carry wages for time paid for but not worked. This includes the pay for the hour often given on Saturday afternoons, and

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for time lost during temporary failure of power, or in waiting for work. Wages paid to men disabled through shop accidents, if not provided for by a special accident account, are charged to "Lost Time." In connection with this account, it is well to note that considerable amounts of lost time may not appear on the cost-sheets. It is easy to compute the time wasted by an arrangement requiring every man in the shop to walk an unnecessary fifty yards to reach a tool room placed in the extreme corner of a building, or a toilet room inconveniently located; or by waiting for supplies or tools at the issuing window, to save the wages of an extra attendant. By refusing cent fractions on the job tickets, there is a small daily discrepancy in the pay roll, which may run from ten cents to several dollars, depending on the number of job tickets per day per man, and this is credited to "Lost Time."

The last of the factory expense subdivisions, "Experiment," covers work done in developing new methods and appliances for doing the factory work; but not experimental work on proposed new lines of manufacture. The construction of devices or machines for the purpose of developing new products is an administrative feature, and work done in this way should be paid for from the general funds, just as if it were done for an outside party.

Passing from factory to office, the next division comprises accounts not directly connected with production, but rather with the management of the production de-

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partment, and with the sale of the factory output. These accounts accordingly do not appear on the records of the factory cost-clerks, but are kept in the main office.

The first subdivision, "Salaries," is distinct from "Pay Roll"; the latter term refers to wages paid to factory employees, productive and non-productive, while the former covers the outlay for services of office employees, designers, salesmen, and administrative officers. If certain special services are chargeable to occasional items of factory product, as drafting or engineering work for the building of special machinery, the men involved should be paid through the "pay-roll" account, and their time charged by regular job tickets; so that the distributable portion of the wages outlay may be kept separate from the undistributable.

"Office Expense" covers a wide range of purchases. In large organizations it may be advantageously subdivided into accounts for stationery and printing, supplies, repairs and replacements of fixtures, and as many others as seem desirable.

"Fire Insurance" and "Taxes" belong in great part to manufacturing expense, being directly related to the factory buildings; but being made up of a few charges at infrequent intervals, are preferably handled outside of the cost-department of the factory. The ultimate result of classifying them with general expense is in no way different as affecting the cost-records. The accident account is preferably carried on the general-office books, in part to avoid undesirable publicity and com-

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ment. It includes the cost of liability insurance, outlay to prevent accidents, payments to men while disabled, and all attendant expenses. In some lines of manufacture this account assumes large proportions. It may well be regarded as chargeable to the administrative department, since the prevention of accidents by guards, safety devices, wise shop rules, and good habits should be one of the most careful studies of the general manager.

“Legal Services” form an item of varying importance. “Royalties” to owners of patents and rights involve heavy charges for some factories, to be periodically computed and settled. If dependent on the number of the several articles produced by the works, each factory order involving the use of the patented device is charged with the amount of the royalty, and a corresponding “Sundries” slip is made out and sent to the office for entry to the credit of “Royalties.”

“Reclamation” covers deductions made in the settlement of disputed accounts, or extra work done and not charged or paid for, or any other expenditure made to satisfy demands reasonable or unreasonable, in order to avoid quarrels, delays in payment, future enmity, or lawsuits. Since the occurrence of such expenses on any particular order is accidental, they are to be carried as a general burden on the work of the concern, therefore as an item of general expense. As reclamation charges represent a money loss, the management will exhaust its best efforts to secure settlements in full, and failing in



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this, will retire with the best possible grace and leave a pleasant impression of liberal dealing which will help to secure more business in future. Some managers make a practice of holding uncollectible charges on the books indefinitely, and find that the practice results in securing occasional settlements of accounts which seemed quite hopeless long ago.

The last of the three general divisions of the expense account is that of "Sales." This division lies quite outside of the cost of manufacture. The goods manufactured by the works are made up and delivered to the shipping department, and the charges for manufacture are complete before the selling expense appears, to form an addition above the manufacturing cost. Some factories dispose of their entire product through an outside sales organization, which carries the expense of advertising, salaries, and promotion. But whether the sales department is or is not part of the factory office force, selling expense, being distinct from manufacturing cost, should be so considered and treated.

Three subdivisions are sufficient for properly recording the expenditures of the selling organizations, and these are symbolized A, B, and C. Advertising, stationery, catalogues, photographs, and printed matter fall under "A." Traveling and miscellaneous expense for the purpose of making sales are charged to account "B." Salaries and all commissions on sales are charged to subdivision "C."

Selling expense is the most indistributable of all ex-

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penses connected with manufacturing. In many cases it is impossible to say what proportion of salesmen's time and expense have resulted in the securing of any single order. A forceful man in the office or on the road will exert an influence day by day, awakening favorable interest among men who may be in a position to influence future purchases of the factory product, and some of these acquaintances may effect the placing of orders, after long periods of time. Where commissions are paid for specific orders secured, they are charged as Sundries to the costs of the orders, and a voucher is made out for each item. The accountant in charge will find it desirable to make direct charges of this nature wherever possible, so as to reduce the total of undistributed expense. Commissions are often made payable conditionally upon the payments being received from the customer, and in such cases the accountant must take care to make proper memoranda, so that the salesman's remittances will not be forgotten when the payments are received for the goods sold.

The cost of manufactured goods has now been reviewed in detail, from the fundamentals of Material, Labor, and Sundries, forming the prime or direct cost, down through the factory expense or "burden," administrative expense, and selling expense. Only after all these have been accounted for can a profit be said to exist.

## CHAPTER X

### THE DISTRIBUTION OF BURDEN

THE items of direct cost, Material, Labor, and Sundries, are recorded as they occur, by entering each on a proper ticket. But the computation of the share of the total factory expense which should be borne by a given factory order is not such a simple matter. Factory expense or "burden," though divisible into component accounts, is not built up of items assignable separately to the several factory orders. Yet it is of the utmost importance that the effect which should be produced on the factory expenses by taking or losing any considerable amount of any certain class of work shall be known to the management. The difference between the prime cost and the selling price is not a proper measure of the profit of manufacturing. It takes no account of the differences in floor space required, in power consumed, in wear of machinery, in interest on special equipment, in time of foremen and helpers, and in all the rest of the factory expenses, which exist in the doing of the various classes of work for which the factory is equipped. The problem for the accountant is to ascertain the amount to be added to the prime cost of each item of work done on each order, to represent a fair charge for the portion

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of the factory facilities that was employed in the particular item of work.

The addition must include a suitable allowance for every item of factory expense or burden which is involved in doing the item of productive work. It is manifestly impossible to analyze each expense item with respect to its relations with each product item; but it is possible to analyze each group of items sufficiently to formulate rules by which approximations may be made to the theoretically correct shares to be borne by each item of direct cost. In bearing its share, the direct cost carries a load which naturally receives the name of "burden." Another term used is "overhead expense," from the conception of the factory expense as over and outside of the prime cost. If the rules are based on correct calculations, the additions to the several orders during a given period, as a month or a year, will be closely equal to the total outlay for factory expense, plus the amount to be set aside as depreciation to provide for the replacement of the shop equipment at the end of its expected life.

As to the manner in which this burden is to be computed, opinions have differed widely. A simple ratio of burden to prime cost is sometimes used, upon the theory that all work done by the shop should carry the same proportionate share of expense. If the cost per unit is substantially uniform, the distribution may be by weight, length, or bulk of a homogeneous product. This method is correct when the works is employed in producing but one kind and grade of product, as pig iron, or steel rails

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of similar shapes and qualities. It is commonly used in foundries, when the melting cost is computed in cents per hundred pounds. It is also suitable for a mercantile business where the chief expenses are the interest on the stock carried, the expenses of the store, and the salaries of the clerks, all of which are indiscriminately concerned with the making of sales, so that the expense may properly be distributed equally over each dollar's worth of goods sold.

The percentage-to-direct-cost method fails when the product is not homogeneous. In a mercantile business where various kinds of goods are kept in stock and sold, the expenses arising in connection with the different classes of stock may differ very materially. Inflammable oils, for instance, require a high rate of insurance, and are subject to serious losses by leakage and otherwise; while heavy commodities, kept in stock in plain buildings located where ground rents are cheap, need no insurance and suffer no loss. It is obviously incorrect to reckon a flat percentage for expense on such different classes of material. Where the element of labor enters, so that the value of material forms only a part of the cost of the product, the addition of a flat percentage to the prime cost becomes decidedly erroneous. A manufacturing concern computing costs on such a basis will fail to secure orders for goods involving much material and little labor, such as steel bars cut to length, in competition with others using more rational methods of distributing burden. A large sale of material on which

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no labor is performed involves no more expense than the interest on the value of the goods for the interval between paying for the material and receiving the purchase price from the customer, with a trifling addition for the handling expense, and the clerical work necessary in entering the order and keeping the accounts. This is so plainly evident that factories using the method of percentage addition generally base it on the cost of direct labor only.

The percentage-to-labor method of distributing burden has limitations nearly as close as those of the percentage-to-direct-cost. Computing burden on this principle, compare the apparent cost of work done by a large machine operated at a rapid rate of production by a skilled man at thirty cents per hour, and the same job on the same tool operated by an apprentice at five cents per hour. The boy will perhaps make but half the number of finished pieces per hour, and each piece he makes will therefore cost one third as much for labor as if made by the skilled man. If the burden rate in this shop is one hundred per cent on the labor cost, each piece made by the boy will appear to cost one third as much as a duplicate piece made by the man. The output of the machine, however, in the hands of the boy is only half as great as in the hands of the man, so that the expensive machine is earning but half as much as it might. Boys require more of the foreman's time, use up tools faster, cause more accidents, and occupy as much space and shop equipment as skilled men. Evidently the tool

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should earn no less per hour's use, but rather more, when operated by unskilled hands. If burden is charged at one hundred per cent on the man's wages, it should be charged at three hundred per cent on the boy's.

It is obvious that the cost of work bears no simple relation to the wages paid the workman, whether for day-work or piecework. It depends no more closely upon the labor cost than upon the expense of operating and keeping up the equipment required by the workman. A worker paid at the rate of thirty cents per hour may be employed on handwork involving the use of twenty-five dollars' worth of tools at most, or on an expensive machine costing perhaps three thousand dollars and requiring say ten horse power to operate it. The interest and depreciation on the machine, reckoned to have a life of fifteen years, with an interest rate of six per cent, will run about thirteen cents per hour on a basis of ten hours per day and three hundred days per year. The ten horse power probably costs twenty cents or more per hour, making thirty-three cents per hour which should be earned by this tool if operated continuously during shop hours; or a higher rate if there will be more or less idle time between jobs. Putting the thirty-cent man on this tool, the burden rate would be 110 per cent on his wages; but using a handy man on special work, at say fifteen cents per hour, the burden rate ought to be 220 per cent. Evidently an equal burden rate for all hands is incorrect. As already suggested, a cheaper man may be actually more expensive in his use of the shop facilities, so that

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the total amount of burden charged on his job ought to be higher than for the best and quickest workman. The percentage-to-labor method often charges the slow worker's job with the smallest share of expense. Wherever hands of different skill and machines of different character are employed, the percentage method of apportioning burden is obviously fundamentally wrong.

In the endeavor to avoid the inaccuracies of the percentage method, the hourly-rate method was devised. The total number of hours worked by all operatives on direct labor during a given period is divided into the total outlay for shop expense in the same time, and the quotient used as an hourly rate; from which the burden addition to each order is computed by multiplying this rate by the number of hours of direct labor charged to the order. This method also gives rise to fallacies under many common conditions. All hand-working equipments and all machines, whether expensive or otherwise, are assigned the same hourly rate, so that work done with inexpensive and cheaply maintained equipment is charged with more than its proper share of the factory expense. Accountants using this method will therefore overestimate the cost of work done on small machines, and underestimate on work suited to large tools.

Consideration will show that the first method of distributing burden, by a percentage on direct cost, is accurate where the materials handled are similar in general nature, and the labor cost is small in proportion. The second method, distributing burden by a percentage



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added to cost of direct labor, is satisfactory for small factories employing operatives whose output is reasonably proportionate to the wages paid; as would be the case where all labor is paid by piece rates, and all hands use similar hand tools or small machines. The third method is sufficiently accurate for shops using workmen of various capacities, but all using the same class of tools or equipment. But a better system is required for the numerous cases where outfits of machinery and tools vary greatly in value and expense of operation. This is the multiple hour-rate method, by which different rates are charged for the several machines, based on their respective costs of operation.

The complete method, properly applied, produces cost-records which correctly show the effect of transferring a piece of work from one machine to another, or from one worker to another. It insures that the factory shall be run with full knowledge of whether the necessary amount is being earned to provide for the maintenance of efficient equipment as machines wear out, or better ones are invented. It provides a system of burden rates so simple that careful though inexperienced clerks can keep correct cost-records, relieving the responsible accountant of all detail of this nature. It does all this by establishing for each machine an hour rate which represents closely the actual cost of operating that machine, maintaining its tools and accessories, and providing an appropriation which, during its probable life, will amount to the cost of replacing the present equipment by a new

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one. The accountant who follows this method of charging burden is constantly assured that the apparent profits are the real net earnings of the factory operation. With the gross cost of the factory orders computed by this method, the total of the gross costs of all the orders passed through the works in a given time is closely equal to the total expenditure for material, direct labor, sundries, burden, and administration; in short, the total expense of the factory organization.

## CHAPTER XI

### THE COMPUTATION OF CORRECT BURDEN RATES

The principles and method of arriving at correct hourly rates, to represent the share of expense which should be borne by each item of equipment, are the same for all factories. To illustrate the process, the floor plans and figures of a hypothetical machine shop have been selected as a basis. Neither plans nor figures are offered as representing approved practice, but merely to illustrate the various steps of the computation. The required table may be equally well constructed for the actual conditions of any factory whatsoever.

The first essential is the plan (Fig. 24) showing the factory with the various tools in position, each with an appropriate floor space marked off about it, for the materials being worked upon, and the convenient movements of the operator in performing his duties. There will naturally be no waste of space between the machines, so that the working spaces will cover the entire floor space, except for such portions as are provided for future additional equipment, for storage of reserve stock or completed work, and for general factory purposes, such as small-tool storage and upkeep, toilet rooms, and

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the like. The table (Fig. 25) is next laid out. In the first column is set down a list of the various items of equipment, forming what may be called the "productive units" of the factory. In the next columns are placed the areas of the floor space assigned to each unit, computed from the floor plan (Fig. 24). The example is a shop with a high story served by an overhead crane, and two stories in the adjacent portion of the building, so that two columns are provided to permit of separating the figures for the two classes of floor space. The fourth column is filled with the figures of the value of the equipment of each unit. Following comes the probable life of each equipment item in actual service. These are estimated chiefly as representing the number of years which the management decides to permit to elapse before replacing the equipment by a new one; for, long before the machine is worn out, progress will have brought forth a better one, and the old must give place to the new, or be worked at a loss to the factory.

The estimated horse power, which follows, is the average supposed to be required to operate the productive unit in the usual course of the work. The figures are therefore arbitrarily set, and must be corrected by comparing the total of the first tentative figures with the known power developed by the engine. In this column note that employees working principally with their hands, such as vise workers, and those using in common and for short periods a general equipment, such as pattern makers and erectors working under a crane, are





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charged with any power used by their equipment, and with the power equivalent of the extra lighting they will require. Next comes the average running hours of each equipment per month, due allowance being made for absence of workmen and idleness of machines in changing work, or by reason of failure to keep the tools supplied with material; and simple multiplication gives the horsepower hours for each productive unit. Depreciation is computed on a monthly basis, providing for the replacement of the tool from the fund accumulated from the set monthly amounts.

To obtain the space charges for the next column, some preliminary computation is necessary. Space in the portion of the building having no second floor, and served by a crane high overhead, is worth more than space where two or more floors help to carry the ground rent. Footing the space columns, doubling the totals of crane space to allow to it double value, and adding the low-ceiling space, the total divided into the monthly rental value of the buildings and ground (in this case taken at ten per cent per year on the supposed market value of \$18,000, or \$150 per month) gives a square-foot value of one and one-tenth cents per month for low-ceiling space, and two and two-tenths cents per month for high-ceiling space. These values multiplied into the square-foot figures give the monthly space charges for each productive unit.

The division of power-plant expense is made by computing the depreciation, space charge, repair expense,

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fuel, labor, and general expense pertaining to it, and dividing the total by the total of the horse-power hours already computed. This apportions the total expense of operating the power plant over the portion of the developed power which goes into useful work; which is sufficiently precise for practical purposes. In the example, the cost of a horse-power hour is found to be three cents nearly, and this price multiplied into the horse-power hours of each unit gives the figures set down in the column PHL.

Repairs to Machinery, column RM, are estimated arbitrarily at first, but as time passes may be approximated more closely from the actual repair account. Repairs to Small Tools (RST) is arbitrarily apportioned, noting the expensive equipment required by certain machines and the trivial tool cost of others. The amounts in this column are set so that the total will agree closely with the total of tool-room expenses, made up of depreciation of tool-making machines, with their power cost and repairs, space charge, and cost of replacement of tools, and of attendance. General Labor and Supplies (GLS) is arbitrarily apportioned with due attention to the extra help and supplies required by the larger productive units, and to the agreement of the estimated total with the actual outlay for this account.

The six items of expense opposite each unit are next added across and the totals entered in the next column. These totals of monthly expense are then divided by the estimated monthly hours to obtain the exact hourly bur-







## COMPUTATION OF BURDEN RATES

den rates. The remaining items of expense not yet provided for are next converted into a monthly total, and this is divided by the total of the hours worked per month by all the productive units, to give a supplementary rate, in the example three cents per hour, which is to be added to each one of the rates already found. The totals are the correct hourly burden rates which should be charged for the use of each productive unit under the usual conditions of service in this factory.

These burden rates, while based on careful reasoning, are obviously not necessarily exact, particularly since the monthly hours of operation will vary. It will introduce no serious error, therefore, to group together those rates which fall most nearly together, and substitute even figures. The scattering rates remaining may then be considered separately. In the example, unit No. 3 has a very high rate, so that it stands quite alone; the manager should endeavor to increase its working hours by adapting other jobs for it, and should have a special record of expense on this tool carried for a few months to ascertain whether the rate can be fairly reduced. Nos. 6 and 7 have rates rather low in proportion to other heavy tools, and may fairly be made to carry the next higher even rate; a special record of actual expense of these also for a short period would be of interest. Unit No. 22 is another which seems well able to carry a higher rate than that estimated. The vise hands do not appear to carry enough burden, and for uniformity are assigned

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the minimum even rate, so that all handworkers will be charged alike.

These rates are most conveniently kept in mind and assigned to the work by classifying the different kinds of equipment into groups designated by the letters A, B, C, and more if necessary. Under class A are grouped all handworkers and workers on such machines as cost for operating expenses practically no more than handwork; class B takes the next group, and so on. On each tool or vise-worker's bench is painted or stamped the class letter representing the burden which this productive unit is to earn. These letters are entered on the job tickets for work done, and indicate instantly to the cost-clerk what burden rate must be charged.

To cover the condition occasionally met with in repair shops of sudden large increases or decreases in outside force, a special class may be provided for temporary outside employees. The addition of fifty or a hundred men under the same outside foreman raises the shop expense but slightly, little if anything more than the interest on the pay roll for these men up to the time the concern will be reimbursed by the customer for the work done. A small special burden rate on the hourly basis can be assigned for extra outside men, so that the total burden charge carried by this variable outside force will closely offset the extra outlay for this class of work.

It will be observed that administration and selling expense, being matters in no way directly connected with

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the factory operation proper, are not included in the table from which the burden rates have been computed. Material, labor, and factory burden make up the total cost of factory product, as it would be computed for a purchaser who comes to the factory with his instructions, and carries off the finished work, after paying his account in cash. All factory product delivered to the warehouse, but not sold, is valued at its direct cost plus its share of the shop expense only. Whatever of the manufactured goods are then sold, must be charged with their proper proportion of the administrative and selling expense. Profit is only earned after these expenses are provided for.

Administration and selling expense are best taken care of by percentage additions to the total factory cost of work. This method provides properly for all cases, whether mere shopwork done upon an unsolicited order, or factory product completed and delivered to a selling corporation, or goods manufactured on a scale requiring designing, planning, financing, and marketing. For finished parts delivered to the stock room, factory burden only is added. For completed product put in the warehouse, factory burden is charged, and administrative percentage added; and for all product sold, the selling expense is added to this gross cost.

To obtain the proper rate for the administrative expense allowance, the accountant must make up a statement of the average monthly total of administrative expenses, for example:

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Salaries .....	\$970.00
General Office Expense .....	100.00
Interest and Discount .....	25.00
Telegraph and Telephone .....	35.00
Stationery and Postage .....	40.00
Experiments and Patent Fees .....	50.00
Litigation .....	50.00
Reclamation .....	10.00
Contributions .....	20.00
	\$1,300.00

Average monthly total of product (M + L + B) = \$12,000

Administrative Expense rate =  $\frac{1300}{12000}$  = 10.83 or 11% nearly.

Dividing the total administrative expense by the total factory cost of product per month, the quotient is the fraction to be used as a multiplier to obtain the necessary figure to add to the factory cost of each order to cover administrative expense. Having added this amount to the total of material, labor, sundries, and burden constituting the factory cost, the total forms what may be termed the gross cost.

The selling expense is similarly treated. A statement is drawn up showing the average monthly total of the three subdivisions of selling expense. This total is divided by the average monthly total gross cost of all the factory orders, thus obtaining the percentage to be added to cover selling expense. The calculated selling and administrative percentages may generally be modified to even figures for convenience. The inevitable variation in current expenses will make it impossible to accurately balance the distributed expense with the actual expense, so that a ratio approximately correct will be sufficient.

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As already stated, it is seldom possible to charge selling expense definitely against the factory orders. For the most part, a salesman does a large amount of "missionary work," and may spend three-fourths of his time for a long period on prospects which come to nothing, and get an important job in a few moments at last. It is thus better to make a practice of distributing selling expense by the flat rate based on the total selling expense as compared with the total sales value.

Theoretically, expense should be charged either direct or by distribution, and not partially by both methods; but as it is desirable to reduce the amount of indirect expense as far as possible by intelligent analysis, it is practically advantageous to charge expense direct wherever it can be properly assigned. Portions of draughtsman's wages, commissions, and expense of high-salaried men may similarly be charged to work. The regular distribution rate may be modified for such cases to compensate. Thus, a large order may be charged with the whole cost of salesmen's time and expense and special commissions, and charged with its share of the general selling expense at a low arbitrary rate, set by mental estimate, instead of the regular five or ten per cent. On the other hand, extra expense incurred for any one department, such as the maintenance of a special purchasing agent to overcome difficulties and delay in the supplying of certain material; a greater share of the time of the general manager or others devoted to one kind of production; the necessity of extending credit on certain

## COST-KEEPING FOR MANUFACTURING PLANTS

classes of goods over long periods, perhaps with a large percentage of bad debts or other losses; and all other special conditions which exist with regard to one department and not with regard to others, should be allowed for by special distributor rates. The figures producing the apportionment should be preserved for reference, so that a verification or reapportionment may be made at any time. The accountant's good judgment will determine whether special charges for direct expense or special distribution rates for indirect expense are desirable for greater accuracy in connection with particular classes of factory product.

Such charges as are preferably kept private are made up by the accountant and given to the cost-clerk as percentages to be added to the gross cost of the product orders, or as several percentages to be used with different classes of product as directed. Throughout the work of computing distribution rates the principle must be kept in mind that items occurring, by reason of the nature of the business, only in particular lines should be distributed as part of the cost of those particular lines and of no others.

Certain special questions arise with regard to some factory work which at first sight seems to be properly exempt from the regular burden charge. All shop-expense work involving the use of manufacturing tools, power, and supplies, and their consequent diversion from paying work, should be charged with its share of burden at regular rates. A skilled man using factory facilities



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for building a new special machine for the use of the shop which employs him is just as much a producing workman as when using the same equipment on regular product. He costs the shop as much for power, heat, help, and other expenses as if he were making the same machine for sale to an outsider. Since this work is occupying floor space and using shop tools and supplies, the true cost of the machine must include the regular charge for the expenses involved in maintaining the productive units employed on the work. This principle holds with regard to all work done for betterments or improvements on any part of the plant. It costs the shop no less to do such work than it would to hire outside workmen to attend to it, except for certain minor reasons which are obvious, and in the special case of work done during periods of slackness in business, when profitable orders are hard to secure. Even then, the expense must be provided for in some way, and if the workmen are kept employed in improving the equipment, the burden is fairly carried by such improvements.

Some managers have deluded themselves by omitting to charge burden on improvement work, and constructing in their own shops machinery at apparently less cost than the same machinery could be bought for from manufacturers making a specialty of such. Common sense will show that this is a fallacy, and that with any sort of sound reasoning the possession of proper patterns, drawings, and experience for making a device makes probable its construction at a lower cost than would be

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possible for men unpracticed in the manufacture of such devices.

On the other hand, work done by tool makers, laborers, or helpers regularly assigned for repairs which in no way improve the condition of the shop, other than to the extent of keeping the equipment in its original good order, is strictly expense labor, and as such should not be charged with any share of burden. The charging of a small special burden on such work, to cover the cost of light and heat, floor space, timekeeping, and other expenses incurred by employing these nonproductive workers, would be strictly correct, but is an unnecessary refinement, adding clerical labor to no great advantage.

It is true that burden rates might fairly be decreased on work done by the factory force itself, as in building special tools. But it is best, on the whole, to charge regular burden or none. If burden were distributed against nonproductive work, it would increase the total of nonproductive expense, and therefore call for an increase in the rates. Burden should therefore be charged only on work which occupies men and tools which under normal conditions are regularly employed on the factory product.

In presenting his report on the correct burden rates which should be used in the factory, the accountant may be met with three objections:<sup>①</sup> The burden rates may seem much higher than those that have been used, under whatever former system was in force.<sup>②</sup> The elaborate figures may appear worthless, because no two months

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will ever show the same total expense, or agree with the average figures used, and therefore the distribution will not agree exactly with the amount to be distributed.

③ Finally, it would seem that the selling price must be set by the market, and not to suit theoretical principles of cost-keeping.

*T* In answer to the first objection, it is admitted that burden rates may seem high when correctly figured. The remedy is not to cut down the rates and trust to luck for success. The nonproducing portion of the factory organization should be brought and kept to the same pitch of efficiency as the producing force and equipment, so that the capacity of the factory will be increased sufficiently to carry the burden. Or, the superfluous labor and expense may be dispensed with, so that the burden rates, computed in accordance with correct principles, will be reduced to reasonable figures.

*T* There is no way to insure an automatically accurate distribution of expense under unusual conditions of business. Such automatism would be undesirable if obtainable; for a contraction in the volume of business due to bad trade, decreasing the number of operatives employed by the works, would then require an increase in the burden rate disproportionate to the actual increase in manufacturing cost. The point to observe is that losses due to a general condition of trade ought not to affect the efficiency of the shop, or disturb the cost-records. The deficit between the distributed burden and the expense account should be covered in the profit and loss ac-

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count as loss due to general condition of trade. On the other hand, under "boom" conditions of business, it will be observed that there is a maximum beyond which the capacity of the shop cannot be easily forced, and near this maximum the efficiency of the works is likely to go down, the high pressure put on all men causing wastefulness and extra breakage of tools and machines, which may not be compensated by the increase in output. Special planning, the introduction of piecework, and other devices of good management may force the maximum production still higher to meet the emergency, but with an accompanying increase in indirect expense. It is likely, therefore, that in an unusual rush of business the distributed burden on the basis of hour rates computed for average conditions will not run much in excess of the expense total. If it does, the rates should be moderately reduced. Variations in the distributed burden due to bad trade conditions or insufficient sales, and not traceable to changes in factory conditions, should in general be taken care of without altering the shop burden charges, and treated as a business loss.

III     The objection from the sales department is met by the obviously true statement, that it is better to suffer a business loss knowingly than unconsciously. If a factory makes a practice of selling its product at less than its true cost, no system of accounting can keep that factory from ultimate bankruptcy. But it must be admitted that there are cases which justify making sales at a loss, provided that other sales can thereby be made

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at gains counteracting the deficits. The sales manager may therefore be justified in making prices below the accountant's report of cost, in some instances; but he will be very greatly assisted by studying the correct cost figures in each case, so that he may notice the exact amount of the loss, and take care to increase profits on other sales sufficiently to reimburse the organization.

If it is decided that expense shall be distributed exactly, a supplementary rate may be computed for each period and used on the cost-records of the following period. The undistributed burden of the period is divided by the gross cost of product to obtain this rate. A simpler way is to enter any undistributed or over-distributed balance in the profit and loss account—where, in fact, it belongs; for if burden rates have been correctly computed, such balances represent trade gains or losses, and not changes in operating expense. Much of the value of accurate cost-keeping methods lies in the ease of comparing one factory order with another; and changes in values of material, sundries, and burden introduce variations not generally due to the operating management. The normal running expense should therefore be determined with all possible care, and the rates once set should be changed only when absolutely necessary because of permanent alterations in conditions.

## CHAPTER XII

### THE ACCURATE METHOD OF TAKING INVENTORY

EVERY competent accountant knows the importance of accuracy in connection with taking stock in a manufacturing plant. The expert factory accountant also knows that accuracy is not easy to secure. Instead of staple articles with definite market value, most of the stock consists of finished parts and unfinished product, each to be valued at not more than cost, consisting of material, labor, sundries, and burden. Among the finished parts there may be some which look like others, but are defective, spoiled by a wrong dimension, or obsolete from a change in design. If the inventory is for appraising a plant, or to aid in computing earnings, the accountant in charge has the responsibility of ascertaining the real value of the finished parts and uncompleted factory product, a far more difficult task than the physical count.

The chief requirement of an inventory is therefore exactness in description, enumeration, and appraisal. Loose methods of whatever kind are to be carefully put aside in connection with stock taking. It was once common practice for the head of the organization to walk

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about his plant with paper and pencil, and himself to list the articles inspected, and place upon them his own valuation. Even with the smallest business, this method produced gross inaccuracies. The condition of the proprietor's digestion on the day of taking inventory might well cause a thirty-per-cent variation in his ideas of values on two successive inventory days. A comparison of two separate inventories taken by the same man in the same plant on different dates might show many articles of equipment and lots of material actually valued higher on one inventory date than on the date preceding, in a way that could not be justified by any conceivable increase in the market price of the articles.

It is hardly necessary to discuss the proposition of inventory-taking by a single responsible man with discretionary powers, since the average business to-day is of such proportions that a force of men are required to cover the necessary ground, even with the quickest and best methods. The actual physical handling, weighing, and counting of the stock carried in a plant employing as few as a hundred men, or in a warehouse of very ordinary dimensions, requires the assiduous application of all the men that can well be spared from the working force, and advantage must usually be taken of a holiday and of as much night work as the inventory force can stand. With such a large number of men at work, the cost of taking the inventory becomes a matter of sufficient importance to make it worth while to devote the necessary time and thought to training this force and

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laying out a method which will shorten the work and insure its accuracy.

The conditions under which business is carried on often make it impossible to pass systematically from one item of stock to the next, and to cover the whole plant by a regular and orderly progression through the letters of the alphabet. The use of several gangs of men working together in different parts of the stock-room or factory is another obstacle to taking a consecutive original list of materials on hand. It is therefore best to make the original record on cards, one for each lot of similar items; and commencing at any number of definite points, to proceed in an orderly manner throughout the plant until everything has been described, enumerated, and recorded on its card. The original cards will be afterwards sorted into an indexed list, which will afford the usual facilities of being grouped in any desired way and totaled in any convenient order. The equipment for taking inventory should therefore consist of a stock of cards sufficient to meet all requirements. The most useful form of card is the old-fashioned three-by-five library index card, with a single round hole at the center near the lower edge.

Several days before commencing the inventory, the available men should be selected and called together for the purpose of instructing them in the course to be followed. A sufficient number of careful men should be chosen, and each should be given one or more helpers, according to the character of the material he is to handle.



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It must be carefully impressed upon these men that in the haste of counting and recording the articles, there will be no time for forming a permanent mental impression of the condition and location of each item, so that their records must be in every case full. Completeness in describing the items will be assisted by printing the cards to give places for name of articles, number on hand, size, condition, place, or manner in which they were obtained (where known to the checker), and purpose for which they are intended. The weight of everything that can be weighed is to be taken and recorded, to serve as a check to the count. The price will be filled in after the count is all over. As the appraisal value may depend upon the condition and the intended destination of the articles, the description must be very carefully given. The cards should be consecutively numbered, so that every card issued to the inventory force may be accounted for, preventing the loss or overlooking of any lot of articles in stock. The cards are completed by attaching strings, as with ordinary shipping tags, which can be done by boys at insignificant cost.

Several days before the official date of the inventory, the force of men is started through the plant, with instructions to commence at suitable starting points in corners or at ends of bins, and progress regularly and in order from lot to lot of material, counting, weighing, and inspecting each lot. The head of each group is charged with the numbers of the cards given to him. He records the data for each lot on a card, and after finishing the

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count, or checking the work of his helpers, ties the card carefully to one of the pieces. This procedure is to be carried through as rapidly as possible, so that without great delay everything in the plant will be tagged. In the meantime the factory work can proceed without serious difficulty, for the stock keeper changes the tally memorandum on the back of the card whenever he must issue a piece from a lot already counted, and the workmen remove the cards from pieces on which they are actually busy, and replace them each night or when the work is finished. If for any reason there are lots of parts being worked on from which one or more must be taken away, extra cards may be assigned to these pieces, and the number deducted from the original card covering the lot.

On the designated date for inventory, the work is commenced by responsible men selected in accordance with the nature of the inventory being taken. If the selling price of a large works is dependent on the result, the men in charge should be members of the force of some disinterested appraisal company. These men now proceed to the actual count, each one having as many helpers as he can conveniently use. If the work of tagging for identification has been well done, the enumerator has now to clip off with scissors the card attached to each lot, verify the condition and number, and proceed as rapidly as possible through the plant. It is not necessary for the inventory force to delay to count every lot of pieces, but only to test occasional lots at random,

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or to satisfy themselves by whatever check seems appropriate, that the cards being taken give an accurate record of the material they are supposed to represent. While this work is going on, the plant must necessarily be shut down, and all persons not employed in the inventory should be excluded from the premises.

As soon as all cards are removed, the work may be resumed as before throughout the plant, and the scene of the inventory is transferred to the office. It is often possible to resume work in certain departments while others are being inventoried, and to postpone the taking of cards from stock which will not be drawn upon until the active stock and the work in progress has been released for use. The first step in making up the record is the assorting of the cards numerically, and checking them over to make sure that all are accounted for. Proper care having been taken throughout the work, there should be no missing cards. The inventory clerks can therefore be sure that everything in the plant has been counted and is on record, since two separate forces of men, having gone through the works, have found nothing which is not represented by its proper record, and have taken up every card.

The cards are next sorted alphabetically by kinds of material, and further arranged by sizes of material, the smallest in each case coming first. This being done, the inventory is ready for pricing. All stock material which is equal to new is priced at market value. The slide rule is useful in computing amounts and prices for this

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purpose, as, being quite as accurate as usual methods of weighing and measuring, its results are for all inventory purposes sufficiently precise. The equipment of the plant and the fixed apparatus of all kinds is to be valued at its original cost, which is to be learned wherever possible, less an amount written off for depreciation, based on the number of years the article has been in use, and its probable future life. Treated in this way, the present value of fixed equipment will be consistently written off from year to year, provision being made for replacement of machines from the earnings of the business before the tools themselves are worn out and must go to the scrap heap. While the rate of depreciation is not properly to be discussed in connection with taking an inventory, it is well to recall to mind that the future period of use of a machine depends quite as much upon the progress of invention as on the wearing qualities of the machine itself. The production of a better machine will terminate the useful life of the present one just as surely as its breakage beyond repair through some accident. The period allowed for the replacement of the value of foundations or buildings on leased property must not be spread over more years than the lease has to run, unless it is permissible to take a chance on the renewal of the lease for a further term, which may be justified in some cases by reason of some knowledge of possibilities in this direction.

When all inventory cards have been priced and again arranged in the order of kinds of material and sizes, an

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adding machine may be advantageously used to foot up the totals of the various classes of material, and a summary sheet made up covering the entire plant. The inventory cards now form a complete card index of everything on hand, susceptible of being grouped in any desired way, and in the best possible order for the opening of a running inventory, if such has not been previously kept. The running inventory, while requiring necessarily some labor each day in the necessary clerical work of posting receipts and issues, will save its entire cost in decreasing the expense of the following inventory, as it is only necessary to check the running inventory, item by item, as each lot of stock runs out and is replenished by purchasing a new supply. If it be found by this daily checking process of nearly exhausted lots that the record is being accurately kept and that the books agree with the actual stock on hand, it may be permissible to dispense with future physical inventories entirely, and to satisfy all requirements by a single summary taken from the pages of the running inventory upon the proper date, and a revaluation of all lots in accordance with the current market prices. The running inventory is preferably kept on cards (Figs. 8 and 9) previously given, though loose-leaf ledgers are preferred by some accountants. One of the two is absolutely necessary in order to continue an orderly arrangement, even though additions or subtractions are made from the kinds of material and finished parts kept on hand. Whichever form is used, the record gives quantity on hand, received and issued,

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and the balance, carried forward either after every issue, or at the close of each group of issues, or at the end of each day or week. It is the work of a moment to note, when stock is low, whether the inventory page shows a balance on hand to correspond with the number found by actual count.

Aside from the direct purpose of the inventory, many things may be learned by the actual process of taking stock, and by the careful study of the inventory record. The tendency of the stock to grow too large is the most conspicuous point which forces itself upon the observer; and with this comes recognition of the fact that the most undesirable articles, those which are unsalable or are rarely called for, are the very ones which are most certainly forgotten by salesmen or foremen who might put them to use, and which, therefore, are likely to lie in stock indefinitely. A careful inventory such as is here described can hardly fail to return its value many times over by reminding the stock keeper of the presence of undesirable items of stock, and preventing the purchase of articles when stock on hand is available, or when there is already an overstock.

## CHAPTER XIII

### THE ROUTINE OF COST-KEEPING

THE work done by the cost-clerks is of the simplest kind. Its difficulty is of quantity only. As the factory product is built up from the separate items of material, labor, and sundries, the items multiply to such an extent that careful planning of routine work effects a large saving in clerical labor. Though the various steps of the process may seem to form a complicated whole, the process as a whole is simple.

The time required for any manual task, for instance, wrapping up a hardware product for shipment, is minimized by careful study of the motions of the fingers, which will be made by the workers, if they are properly induced by piecework payment. Clerical labor cannot be paid for at piece rates, and cost-clerks cannot be expected to develop the routine they are to follow; the trained accountant should lay out his scheme in advance, and require his assistants to follow his methods exactly.

The routine work of cost-keeping has been described as consisting of four steps: the posting of values to cost-sheets from tickets for (1) material, (2) labor, and (3) sundries, and (4) totaling the cost-sheets when the factory work is completed. The full description of the ex-

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act method of doing any simple task with the minimum of time and effort always seems more complicated than the actual work in the doing. For instance, in the simple operation of nailing up a box, the packer would be directed to take up the first board in his right hand, turn it smooth side up, place it in position, take a nail of proper size with his left hand, place it upright at one extreme corner of the board—and so on until the last blow has been struck with the hammer. The description would require careful study by a high-priced man; but the work would be suited to a mere factory “helper.” The accountant should bear in mind that while he sees the whole accounting process at a glance, with each step in its relations to all others, the untrained assistant can follow only one step at a time. If the clerk at the head of the cost-keeping department observes correct methods exactly, his labor will be lightened, and the possible scope of his day’s work will be increased so that the expense of correct cost-keeping will be comparatively trifling.

The printed forms for use in the cost-keeping department are five in number. They are the three “tickets” for material, labor, and sundries, already shown by Figs. 11, and 18 to 23; two charge sheets, one used for material and sundries, and the other for labor; and a summary and invoice sheet.

The supply of these forms should be kept in the cost-department, and issued from there as required. Whenever a new supply of any form is received from the printer, a sufficient number of packages of the sheets to



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last for four weeks (or more if preferred) is to be tied up and labeled "When this package is opened for use, order new supply immediately." By observing this instruction when the time comes, there will be no danger of a shortage of printed matter.

The tickets covering the previous day's work are to be delivered to the cost-clerk as early as possible in the morning. Material tickets come via the stock room, where the stock keeper has placed them in series by factory-order numbers, after checking off the issues against the bills of material which show him how many of each article he is permitted to deliver for each order for standard factory product. Miscellaneous and expense items cannot be provided for by bills of material, and for these the stock keeper is expected to use his own judgment, and to advise the accounting department of any unusual or apparently unnecessary call for stock material on any order or expense account whatsoever. Labor tickets come via the several foremen, who are required to look over and stamp or initial each job ticket representing work done under their direction, to certify that they approve of the facts, particularly the time, as given. Sundries tickets come from various sources, as from the receiving clerk for petty-cash payments on trifling purchases, or the cashier or bookkeeper for miscellaneous accounts-payable chargeable to factory orders, or any other person connected with the works who may have been authorized to incur expense for sundries to forward factory work.

## COST-KEEPING FOR MANUFACTURING PLANTS

The three kinds of cost tickets are put into plain wooden trays like card-index drawers as soon as received by the cost-clerk, one kind in each tray, to prevent accidental misplacement of tickets. The first step deals with the material tickets, which are to be priced, charged off the running inventory, distributed and totaled by orders, entered on the charge sheets, and filed away for future reference. The unit prices are taken from the inventory cards or sheets, the amount computed, and the values entered on ticket and inventory at the same moment. In small factories the stock keeper may do this part of the work, and if no running inventory is maintained, he prices from a memorandum book kept up to date by entering the unit price of the last lot purchased, as the invoice is passed for entry in the general accounts. Price changes add to the difficulty of comparing costs for the purpose of observing fluctuations in efficiency of management, so that it is best not to attempt to follow the market changes too minutely. If preferred, the accountant may arrange to have the manager or purchasing agent notify the cost-clerk when prices of material should be altered, and use the same prices continuously until they are thus changed. The strictly proper way to figure the charging price when a new lot of material is received is to add the book value of the material on hand to the invoice value, plus freight charges, of the new lot, and divide the sum by the total number of units in stock, thus averaging the former and present prices to form a new unit price. The exhausting of any lot will

I  
material  
tickets

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then result in the running inventory showing a zero value, as should be the case; and the cost-records are not as much disturbed by sudden changes in market quotations.

MATERIAL DISTRIBUTION	
JUNE 10, 1910.	
1248 .....	\$12 17
1250 .....	1 00
1251 .....	22 48
1260 .....	19 80
1272 .....	25
1273 .....	48
1284 .....	1 25
1290 .....	2 30
RB .....	10
RST .....	2 50
DML .....	50
PHL .....	62
Total .....	\$63 45

FIG. 26.—DAILY MEMORANDUM OF MATERIAL DISTRIBUTION.

In large works it may save time in pricing to sort the material tickets so as to put together those calling for the same kinds. After pricing is completed, the tickets are sorted by factory orders. An ordinary blank statement is then placed at hand, the cards of each factory order are totaled, and the amounts set down, as shown by Fig. 26. When all totals have been entered, the sheet is footed, dated, and filed away for future reference.

The material tickets are now to be entered on the material charge sheets (Fig. 27). There is a charge sheet, or several sheets, for each factory order in progress, as well as for each expense account and plant account. The

## COST-KEEPING FOR MANUFACTURING PLANTS

sheets for the factory orders are designated by the order numbers, and those for the plant and expense accounts by the letter symbols already given. In jobbing, or unstandardized, work each material item is entered as its

COST OF MATERIAL

Ordered by Jones & Co. P. O. 1422 A  
 For Wood Tank Frame - Clayton, N.Y.  
 Description 12x12 - 40 ft. high.

No.	ITEM	Mat	D. or Pun.	ISSUES	Total	Rate	Value
4	1x8-16 Posts	16	rd	4	344	30 <sup>00</sup>	10320
8	1x8-20	.	.				
40	3/4x12 Bolts	8		rd 16	40	22	880
16	3x8-16	16					
16	1x20 Rods, 2 nut	8					
32	Washers	64	rd				
	(etc.)						

9 1/2 x 11 inches

FIG. 27.—MATERIAL CHARGE SHEET.

ticket comes to hand. With standard product, each factory order as issued is provided with a bill of material furnished by the designing or planning department, and describing in regular order each item of material required for completing the specified work. The sheet shown by Fig. 27 is filled out to represent some of the parts required for a wooden tank frame, and three issues of material from stock against this factory order, each issue being reported to the cost department by a material ticket. A copy of each bill of material should be given to the stock keeper to guide him in issuing material, and

## THE ROUTINE OF COST-KEEPING

prevent any loss by indiscriminately taking out more than the factory order requires to make up for parts stolen or carelessly lost or wasted.

If the factory product is made up of several kinds of material, the charge sheet can be provided with a column for each kind, in which the weights of material issued from stock for the work may be kept separately. This method allows of totaling the amounts of each kind of material by itself, so that footing the column shows the totals of the amounts of each kind, as, for instance, iron, brass, and babbitt. Having amounts and values separated in this way, it is easy to forecast the change in cost caused by change in the market price of one or more kinds of material.

Each material ticket is thus entered on its proper charge sheet. After all are posted, the cards are filed away by order numbers. It will be found convenient to provide guide or index cards to separate the cards of each order from those of the next; but as the number of guide cards will eventually become very great, the same set can advantageously be made to do duty repeatedly. For this purpose the index cards are purchased in sets numbered from 1 to 999. A few cards of different colors are provided, to mark the even thousands. Factory-order No. 1,000, for instance, is indicated by one of the latter cards with the figures inserted in pencil. Following this card come the cards of the numerical series 1 to 999, and next another special card marked in pencil 2,000, and so on. After a few weeks the earlier orders

## COST-KEEPING FOR MANUFACTURING PLANTS

will be completed and thereafter rarely referred to, so that the earlier sets of numbered cards from 1 to 999 may be withdrawn and used again for later thousands. The best and heaviest grade of index cards may thus be purchased and made to do duty repeatedly without further expense.

JUNE 10, 1910.		
DISTRIBUTION OF LABOR		
	HRS.	AM'T.
1248 .....	48	\$10.20
1249 .....	½	.15
1250 .....	2	.50
1251 .....	72½	17.50
1258 .....	30	7.20
1260 .....	32	7.58
1272 .....	1	.30
1273 .....	2½	.68
1284 .....	5	1.40
1290 .....	9	3.00
1295 .....	12	2.70
RB .....	1	.28
RST .....	9	3.25
PHL .....	10	2.75
FM .....	2	1.00
Totals .....	236½	\$58.49

FIG. 28.—DAILY MEMORANDUM OF LABOR DISTRIBUTION.

*II*  
*labor tickets*

The labor items are posted from the job tickets, brought to the cost-department from the time clocks, foremen's racks, or card-deposit boxes, according to the factory system in use, after being run over and approved by the foremen under whom the work was done. First, the job tickets are sorted by workmen's numbers, and wages and burden computed. Each workman's jobs are next totaled and verified with the time-clock or time-

## THE ROUTINE OF COST-KEEPING

check record to see that all time spent in the factory is accounted for. The wages and burden are best computed by the aid of a wages table covering every rate and division of time used in the factory. Half hours are generally found small enough fractions for practical purposes, but quarters, and even special clocks recording tenths or hundredths, have been advocated and are used with satisfaction in some lines where jobs are short and supervision close. After computing the value of the labor represented by each job ticket, and the burden to be charged, the day's pay roll is made up. This operation is facilitated by computing in advance the total amount of the pay roll of all employees for a full working day. As each irregular time card is reached, the "over" or "under" time is computed, with the corresponding addition or subtraction of wages, and the amount is set down in one of two columns headed "Over" and "Under." The difference between the totals of overtime wages and losses by short time is added to or subtracted from the standard full time pay roll, thus giving the correct total of wages for the day. This is compared with the day's "Distribution of Labor," and the amount of the small difference due to the use of even figures instead of fractions of cents is noted. This difference depends upon the number of separate job tickets, but varies little from day to day. If the discrepancy seems too large, the items for one day may be computed in exact fractions or to several places of decimals, and the accuracy of the figures verified, thus showing the correct differ-

## COST-KEEPING FOR MANUFACTURING PLANTS

ence, which may be expected to occur from day to day with little variation. Any considerable increase in this difference indicates a probable error in the day's calculations.

The job tickets are next sorted by factory-order

COST OF LABOR													
Ordered by	<i>Johnson Lumber Co. S. O. 1524</i>												
For	<i>H. S. Engine</i>												
Description	<i>12 X 18 HOR.</i>												
Date	Boiling	Planing	Drying	Sawing	Grinding	Planing	Drying	Sawing	Grinding				
	<i>Cylinder</i>	<i>2</i>	<i>60</i>	<i>4</i>	<i>50</i>	<i>5</i>	<i>240</i>	<i>5</i>	<i>1225</i>	<i>70</i>	<i>245</i>	<i>100</i>	<i>250</i>
			<i>Scrap</i>	<i>5</i>	<i>185</i>	<i>5</i>			<i>7</i>				
	<i>Blank Head</i>		<i>5</i>	<i>4</i>			<i>5</i>			<i>5</i>			
	<i>Plan Head</i>												
	<i>(Fees)</i>												

9 1/4 x 11 inches

FIG. 29.—LABOR COST-SHEET.

numbers, the tickets for each order are totaled separately, and the numbers and respective amounts set down on a statement form dated and headed "Distribution of Labor" (Fig. 28). The labor and burden items are then posted to labor cost-sheets (Fig. 29), provided, like the material cost-sheets, one for each factory and expense order. At this point a choice is offered. ① The tickets for each order may be lumped and the totals



## THE ROUTINE OF COST-KEEPING

posted, or <sup>①</sup>the cards may be totaled in groups, or <sup>②</sup>each job ticket may be posted separately. The first method <sup>③</sup> is suitable for work of a homogeneous nature, or where details of cost of separate parts are not required. The <sup>④</sup> posting of tickets separately is done where complete subdivision of cost is desired, to afford means of ascertaining the cost of every individual part of an article of manufacture, and of comparing the time taken by different men on similar operations.

The group method is a compromise between the mass total of the first and the extreme elaboration of the third and is especially suitable for factories whose product consists of similar articles, differing in detail and size, but all divisible into the same general sections or parts. Such a group system can be advantageously applied in factories producing several standard styles or sizes of product. The groups used in a factory which constructed steam engines were nine in number. Patterns for making the necessary castings were numbered in the group system, the first cylinder pattern being 201, the next cylinder pattern 202, and so on. If pattern 201 is altered, it becomes 201A; and a second alteration would make it 201B. The same numbering is used to classify the work on the several parts. Labor in boring the cylinder is classified under group 1; babbitting frame bearings under group 2, etc. In assembling the engine, the groups begin at No. 11, for these groups cover labor and supplies only, and no patterns are concerned in them.

# COST-KEEPING FOR MANUFACTURING PLANTS

## GROUP SYSTEM—U. S. MFG. CO.

*Patterns* to be marked with three or more figures, the initial figure to correspond with the group to which the casting belongs.

- 1.—Cylinders, valves, heads and covers.
- 2.—Frames, caps, bearing parts.
- 3.—Sub-bases, generator bases, miscellaneous parts.
- 4.—Main moving parts, pistons, connecting rods, crank weights, etc.
- 5.—Minor moving parts (valve motion, pumps, governors) except fly-wheels.
- 6.—Wheels and pulleys.
- 7.—Boiler fronts, grates, boiler castings.
- 8.—Feed heaters, condensers, pipe fittings, stop valves, etc.
- 9.—Lagging and all miscellaneous and unclassified parts.

Alterations shown by affixing A, B, C, etc., to numbers.

*Job tickets* to be entered in groups as follows:

- 1.—Cylinders and heads, lagging, false heads, valves, spools and balance rings, pressure plates, port bushings, steam chests and covers, piston-rod glands.
- 2.—Frame caps, shells and covers, and babbitting the same.
- 3.—Sub-bases, generator bases, pedestals, and babbitting.
- 4.—Pistons, connecting rods, crank shafts, and crossheads, and babbitting.
- 5.—Valve motion, governor arms and all small parts, including valve stems and stuffing boxes, Corliss bonnets and blind flanges.
- 6.—Wheels and pulleys.
- 7.—Boiler fronts and castings.
- 8.—Flanges, elbows, pipe connections, etc.
- 11.—Set up cylinder, frame and main parts, shaft and governor wheel.
- 12.—Oil guards, oil pipes and pump, and indicator motion.
- 13.—Connect valve gear and small parts of governor.
- 14.—Test engine.
- 15.—Take down and clean engine.
- 16.—Extras.

All studs and tap bolts to go with parts in which holes are tapped.

If the group system is used, the labor cost from the job tickets is entered, each day's on a line by itself, each group in its own pair of columns, labor and burden side by side. This method affords the maximum convenience in verifying the work of the cost-department, and in obtaining a summary of the cost of unfinished work whenever desired. It does, however, obscure the items so

## THE ROUTINE OF COST-KEEPING

that it is impossible to compare the cost of boring cylinders, for instance, without going back to the job tickets and finding the particular one recording the operation. This difficulty may be partially overcome by indexing and filing the job tickets after posting them, so that they are arranged by operations rather than by order numbers.

The method of recording labor details by posting the job tickets separately, employs two sets of cost-sheets. This method should not be attempted except with an experienced cost-keeper and assistants, and a planning force capable of laying out the whole schedule of machine work, and providing labor cost-sheets filled out in advance to show each piece and operation in proper order. If tried without adequate preliminary work, the method fails miserably, for if the cost-clerks do not know the order and extent of the factory work on each item, their sheets are not properly laid out in advance, items are soon crowded into insufficient space, and the records fall into hopeless confusion. Of the two sets of cost-sheets required, one is a simple summary, on which the total labor cost and burden charge for the day is posted, each factory order having its own sheet as usual. The other sheet is filled out on the same printed form, but, as shown by the entries on Fig. 29, provides a place for each job ticket to be entered separately. The entries shown on the sheet represent part of the schedule for the work of building a steam engine.

The first item is the cylinder, and opposite, the first double column is headed "Boring," and in it are entered

## COST-KEEPING FOR MANUFACTURING PLANTS

the items of labor on this work as the cards come in, and opposite, the burden. The next double column is headed "Planing," the next "Drilling," and so on until all operations have been provided for and the cylinder is ready for assembling with other parts. The assembling would be similarly scheduled and set forth.

Whichever method is followed, the hours, labor and burden cost is posted from each ticket or group of tickets, and the tickets are then filed away with the material tickets, for reference in case of need.

*III  
Sundries  
tickets.* The third step in the routine is the posting of the sundry charges. These are recorded by pink tickets, already shown by Fig. 23, on page 122. A sundries ticket is made out, as already stated, for each miscellaneous item chargeable direct to a factory order, each expenditure for carfare, telephone toll-station charge, and postage-stamp purchase, and all similar items. The counter-signing of these tickets by the cashier or clerk acting in that capacity is necessary to guard against loss or fraud, for no exact check, as by weighing and counting material, can be obtained in most cases involving cash payments of small amounts.

Sundries tickets are posted on extra material-sheet forms, one being provided for each factory order on which a sundry charge occurs, and are then filed away by factory-order numbers, with the material and labor cards. In cost-keeping for a product which involves numerous such items, there may be sheets enough to form a third set or book, devoted to sundries. Usually,

## THE ROUTINE OF COST-KEEPING

however, two loose-leaf holders with sheets, making two books, are sufficient for the desired detail.

Since the values represented by the tickets have all been posted to the charge sheets, it is not necessary to preserve the tickets indefinitely. When the cost-record of a factory order has been completed, so that questions involving the correctness of the posting can no longer arise, and after a reasonable interval, three months or six months, or more, if preferred, all the tickets pertaining to the order may be destroyed; or certain tickets useful for future comparisons may be set aside and reindexed by kinds of work done, so as to afford a comparison of the cost of similar operations performed at successive intervals. Job tickets so filed are useful for estimates of probable cost of similar work, as a basis for investigating piece or premium rates, and for many other purposes. Material and sundries tickets are usually of very slight reference value after the order is once completed.

The rest of the routine work of the cost-clerk requires very little time or trouble. As the factory orders reach the cost-department, the necessary material, labor, and sundries cost-sheets are filled out, each giving a memorandum of the terms of the order in the spaces provided, with the serial number. The sheets are then put with the other current order sheets into loose-leaf holders. Additional sheets of each kind may be inserted if necessary to accommodate the charges on complicated work. The most convenient holders for these sheets are those

## COST-KEEPING FOR MANUFACTURING PLANTS

holding the sheets by perforations, on split, hinged rings, as "Simplex," "Unimatic," "Rotamatic," and others known to the stationery trade. These afford means for quickly inserting and removing sheets as required. If the detailed cost of each part is to be kept by itself by posting the job ticket separately, the cost-clerk is to be furnished with the necessary charge sheets made out in the prearranged order by the planning department; with standard work the sheets may be printed in lots, with the names of the parts on them. Another detail of the routine is the daily checking of the receiving memorandums against the invoices for materials shipped to the factory. If goods are directed to be invoiced in duplicate, the copy only of each invoice may be sent to the cost-office for checking, while the original is retained by the accounting department. Except in very large works, covering much ground, or consisting of scattered buildings, the single invoice will be found sufficient, and it has the undoubted advantage of simplicity.

The method of closing up and summarizing the factory-order cost-sheets, the remaining detail of the cost-department routine, will be described in the chapter following.

## CHAPTER XIV

### SHIPPING, SUMMARIZING, AND INVOICING

THE receipts of the factory are derived almost entirely from sales of its product. Since collections follow shipments, the careful recording of every item, however small, which leaves the works is of vital necessity. The shipping clerk is therefore an important member of the works accounting force. In a small factory, receiving, stock keeping, and shipping may be entrusted to the same person, or the shipping may form part of the duties of an available office man.

All manufactured articles, tools, or supplies leaving the factory are invariably to be taken or sent via the shipping room. If possible, this should be insured by fencing the yard, and closing all doorways and gates other than the one where the shipping clerk is stationed, so that nothing shall leave the factory without his knowledge. Failure to invoice a shipment often results in the loss of its value. It is surprising to many an accountant undertaking the reorganization of factory methods to find how large is the loss of revenue because of shipments slipping out unnoticed.

The first rule for the shipping clerk is that he shall permit no goods to leave the works without a written

## COST-KEEPING FOR MANUFACTURING PLANTS

order giving full shipping instructions. These instructions are provided for by the yellow duplicate of the factory order made for this purpose. In this way it is made difficult for unwarranted persons to secure deliveries of goods or tools; or for articles to be shipped incorrectly, as to the wrong customer or destination.

The next point is to verify the condition of each lot of manufactured articles laid out for shipment. In all cases where goods are made up to order of the customer, rather than taken from standard stock on the shelves, the foreman or a regularly appointed inspector should examine each lot carefully, and verify to the shipping clerk that only the articles ordered are being shipped, and that the goods are fully up to the standard of the manufacturer, and presumably in accordance with the expectation of the purchaser. The inspection being successfully passed, the inspector signs the factory copy of the order certifying to the satisfactory completion of the work, and transmits it to the shipping department with the articles. The shipping clerk takes charge of packing the goods, and delivering them to the transportation company, or direct to the customer if the destination is local. He first carefully checks the shipment in detail to satisfy himself that the articles are correctly described, counted, and packed; and makes out in triplicate a packing list or "shipping memorandum" (Fig. 30). The first, or white, copy he sends to the cost-department, with the yellow duplicate of the shop order, and the works copy signed by the foreman or his representative. The sec-



LIST AND COST OF GOODS SHIPPED  
 LIST TO BE SENT TO MAIN OFFICE WHEN COMPLETE

SHIPPED TO General Machine Co  
Buffalo, N.Y.

SHIPPED May 5, 1907 via N.Y. C. CHECKED Bo

OUR NO. <u>1570</u>	THEIR NO. <u>a 1227</u>	WEIGHT
---------------------	-------------------------	--------

CUSTOMER'S COPY OF RECEIPT  
 U. S. MANUFACTURING CO.

NEW YORK

SHIPPED TO General Machine Co  
Buffalo, N.Y.

SHIPPED May 5, 1907 via N.Y. C. CHECKED Bo

OUR NO. <u>1570</u>	YOUR NO. <u>a 1227</u>	WEIGHT
---------------------	------------------------	--------

LIST AND RECEIPT FOR GOODS SHIPPED BY

U. S. MANUFACTURING CO.

NEW YORK

SHIPPED TO General Machine Co.  
Buffalo, N.Y.

SHIPPED May 5, 1907 via N.Y. C. CHECKED Bo

OUR NO.	THEIR NO.	WEIGHT
<u>200</u>	<u>1 X 12 Mach. Bolt</u>	<u>350</u>

RECEIPT OF ABOVE IN GOOD ORDER ACKNOWLEDGED BY

N.Y. C. Bo

8 1/2 X 11 inches

FIG. 30.—SHIPPING MEMORANDUM.

## COST-KEEPING FOR MANUFACTURING PLANTS

ond is sent out with the goods, if they are delivered locally by messenger or team, the receipt of the goods is acknowledged by the signature of the recipient upon it, and the sheet is then brought back to the shipping clerk for permanent filing. If the consignee is located out of town, the shipping clerk retains this copy, and affixes to it the receipt of the transportation company, sending a duplicate of this receipt or bill of lading to the customer to assist him in obtaining the shipment without delay. The third copy of the shipping memorandum is packed with the goods, for convenience in checking off the articles when they are received. If the purchaser requires that signed receipts be attached to the invoice when rendered, extra carbon copies are made out as necessary. In a large office, or with work of a character which necessarily delays invoicing, the bill of lading with a letter of transmittal may be sent out immediately after the shipment, leaving the invoice to follow later.

→ The subject of shipping might well fill a book. In the larger industrial organizations the work is divided among general agents, route clerks, and other men with definite and special duties, who devote their efforts to devising ways and means of shipping with the greatest security, by the quickest route, and at the least expense. The shipping clerk of a small factory has but limited ability to cover so large a field. He can accomplish much by making friends of the various freight agents who handle his shipments, so as to facilitate obtaining information regarding classification, rates, and routes, and

## SHIPPING, SUMMARIZING, INVOICING

expedite claims for damage or loss of articles in transit. Eliminating special freight rates to favored customers, the shipper may yet reduce freight charges in some instances by proper description of articles known locally by one name, but substantially the same as other articles known to the tariff sheets. Thus, a cylindrical apparatus of steel plates may be shipped as a "boiler" even though not actually used for steam making, and defective parts may be returned as "scrap," which they certainly are, under whatever classification they may have been received. Sometimes a light crate permits an article to go "boxed" at a low rate, or the removal of a few projecting parts may classify a machine as "KD," at a considerable saving. Often a shipment goes at carload rate at the minimum weight allowed to a car, for a sum less than required for the same weight shipped at the less-than-carload rate. On some routes it is possible to ship for part of the distance at less-than-carload rate computed on the actual weight of the shipment, and thence at carload rate to destination, taking advantage of a lower minimum allowed over the terminal route. These matters are easily within the comprehension of an alert shipping clerk with tact enough to make friends among the transportation men.

In the matter of prepaying freight on shipments, many of the larger shippers have fixed upon the principle of selling goods "free on board cars at factory, freight allowed to destination." This delivery requires the consignee to pay the transportation charges, but per-

## COST-KEEPING FOR MANUFACTURING PLANTS

mits him to deduct the amount from the face of the invoice. The goods thus cost him the same as by prepaid freight, but with the important difference of releasing the manufacturer from liability for delay or damage after the shipment is delivered to the transportation company. It is obviously unfair for the shipper to be charged with liability for matters not under his control, while the transportation company may as well be responsible to the consignee as to the consignor. Delivery "freight allowed" is now commonly offered and accepted, and should always be specified in quoting prices, unless expressly refused by the prospective purchaser.

Some unscrupulous houses have been known to make a practice of taking lists of the addresses of their competitors' shipments as they lie in the freight stations awaiting loading in cars, with the purpose of canvassing those parties later and seizing the trade. To prevent this, symbols have been used, corresponding to marks on the bill of lading, no name appearing on the packages shipped. This practice has resulted in numerous cases of delay and loss in transit. If some of the articles so marked become separated from the rest of the shipment, in the absence of the waybill, identification of the owner or destination is impossible. One scheme that has been successfully used is the enclosing of the tag bearing the full name and address of consignee in an envelope showing destination only, with a printed notice to the freight agent at destination to open the envelope and deliver accordingly. This makes it impossible to ascertain the

## SHIPPING, SUMMARIZING, INVOICING

names of customers by casual inspection of the addresses on the packages.

Whatever the route or manner of shipment, the shipping office has completed its work when the goods have been delivered to a responsible person or corporation and a receipt secured. As soon as the first or white copy of the shipping memorandum is received by the cost-keeper, he enters the date on his copy of the factory order, and if the shipment covers only part of the quantity ordered, he notes the amount also. If the shipment completes the factory order, the cost should be made up immediately so as to show at once whether the work has produced profit or loss. The material, labor, and sundries charge sheets are first gone over to note whether all items have been entered, either in accordance with the bill of material, or with the cost-clerk's knowledge of the work done, or by conference with the foreman in charge, if the work was novel or of indeterminate nature. If special material was used, and no invoice has been received, its price should be ascertained by telephone, or even estimated, and if necessary to obtain an instantaneous report of the cost, time worked on the very day of shipment must be taken up or estimated in advance of completion, and entered on the charge sheet.

When the complete tabulation of material, labor, and corresponding burden and sundries is ready, the cost-keeper proceeds to group the items and enter them on a summary sheet (Fig. 31). According to the detail wanted, the different materials may be shown separately,

U. S. MANUFACTURING COMPANY.

DESC. 12X12 H.S. Engine R. W. Atchins Co.

100 SUMMARY OF COST OF SHOP ORDER NO. 1122

Ques	DESCRIPTION	Plan	Matt	Labor	Prime Cost	Expense	Cost
	Cylinder Group	4750		5100	10450	3728	14170
	Frame Group	6250		4250	10500	4440	15340
	Main Moving Part	7520		4400	12320	3175	15495
	Washer	1200		2225	3425	1045	4522
	Wheels	9050		2260	11270	2440	14716
	Wires	12100		700	19400	4550	24444
	Electrical, etc	-		3240	3240	1750	5090
	Total						71197
	Add. Gen 11%						7829
	Gen. Sell 6%						4291
							82797

FIG. 31.—SUMMARY OF COST-SHEET.

U. S. MANUFACTURING COMPANY.

ROUGH DRAFT OF INVOICE FOR R. W. Atchins Co. St. Louis Mo

OUR ORDER 1122 THEIR 197011 DESC. 12X12 H.S. Engine.

1	12X12 High Speed Horizontal Engine, per contract,						99400
	FOB N.Y.						

11 x 17 inches

FIG. 32.—"ROUGH DRAFT OF INVOICE."

## SHIPPING, SUMMARIZING, INVOICING

as steel, brass, etc., and the labor by trades or machines, each item to be priced at the appropriate figure; or the items may be grouped according to the details of the production, the parts of frame, wheels, etc., together; or in any other way desired. Items of material or labor which may have crept in, though not properly chargeable to the job, should be taken out and transferred to the appropriate plant or expense order. Expenses for drawings, patterns, and special tools should be separated, and assembling, testing, and packing shown separately from construction. Errors being eliminated as observed, and the items grouped and arranged symmetrically with the cost-sheets of similar previous orders, all extensions are made, and the columns footed. The completed summary thus shows the totals of material, labor, sundries, and burden on the factory order. Sub-totals are provided as desired for the purpose of comparison with the cost of corresponding portions of similar work, and to separate any portions of the work which are to be transferred to other accounts. The administrative and selling expense percentages are computed and set down, the gross cost totaled, and the summary is complete.

The totals of the several columns are next entered on the Register of Completed Orders (Fig. 33), on sheets similar to those used for labor, on which are set down the totals of material, labor, sundries, prime cost, burden, and gross cost of each order as it is completed and the cost made up. If it is desirable to divide the product into different classes, a separate register sheet is kept





## SHIPPING, SUMMARIZING, INVOICING

for each class. After each order cost is posted on the proper register sheet, the cost-sheets are filed away numerically in transfer covers.

The proper invoice or charge should be made immediately after the goods are shipped. If the order is not shipped complete, the partial shipment should be invoiced without delay at its proportionate value. Even when labor is to be performed after shipment of material, <sup>if in setting up machine,</sup> the value of the material should be charged to the purchaser immediately after shipment, to provide a record on the sales book, and prevent forgetting to make the charge and overlooking the account. As the difference between the total cost and the selling price is the profit, it is desirable that these two amounts be recorded on separate sheets, so that the amount of the profit or loss shall not be a matter of common knowledge in shop or office. To attain this end, there is provided a form shown by Fig. 32, entitled "Rough Draft of Invoice," similar in size to the summary sheets and (conveniently) attached to it, but perforated along the division line for easy detachment. On this form the necessary memorandum for making out the invoice is entered, after which the sheet is torn apart, and the cost-sheet at once returned to the cost-department, thus separating the cost-record from the price-record. With the "Rough Draft of Invoice" are filed all papers bearing on the transaction, for future reference.

In factory work where the manufacturing unit is not the sales unit, so that there is no direct relation between

## COST-KEEPING FOR MANUFACTURING PLANTS

the cost of an order and the amount charged the customer for a shipment, the double cost-and-invoice sheet is similarly used. Each lot of goods as made up is charged to "Completed Product" at gross shop cost, without selling expense. When a sale is made, another order is entered for the goods, and their value written off the ledger account of "Completed Product"—usually kept on cards like those of the running inventory of material—and entered on the summary sheet for the sales order. The addition for selling expense is then made, the price set, and the charges entered and invoiced.

The book entries required in connection with invoicing are as follows. A carbon copy of the invoice is filed in a loose-leaf holder, forming, together with the previous invoices, the sales book. The amount of the invoice is credited to "Product," and debited to the purchaser's account. The gross cost is debited to "Product" and credited to "Work in Progress." The difference between the debit and credit sides of "Product" is the gross profit, subject to reduction by any failure to collect the full amount of each invoice, and to modification by the variation between the distributed and actual burden and expense.

Where commissions are payable to salesmen or agents on goods sold, the amount of the commission is computed and entered on the general accounts at the time of invoicing the shipment. Such commissions form part of the cost of doing business, but not part of the manufacturing cost. It is desirable to make such charges pri-

*compare  
with page  
15.*

## SHIPPING, SUMMARIZING, INVOICING

vately in the general office, rather than in the cost-department. Since the debit side of Product is made up of the cost-totals of the factory orders sold, sales commissions cannot be treated as an element of cost and charged there without destroying the agreement with the total of the Register of Completed Orders. The selling expense account C, being for indistributable salaries and expense of the sales department, cannot receive items forming direct charges. A special commission account must therefore be carried, to be charged with all commissions on sales, and closed into Product at the end of each accounting period.

## CHAPTER XV

### THE PERIODIC REPORTS

EACH employee of a manufacturing organization has certain points of interest in the cost-keeping where it touches his particular division of the factory work. The workman is interested in the time cards, by which his performances may be compared with those of other dates and other workers. The stock man is interested in the entries on the material tickets. The foreman must give attention to both. The accountant is interested in all the details, as well as in the general results, and draws from the cost-system information which enables him to make useful comparisons with previous records of manufacturing and commercial operations. To inform department heads and relieve them of minutiae, he arranges for making summaries of the items in groups so as to provide comprehensive surveys of the situation from every point. The summaries of cost of the several factory orders form the first step in the series. But as these are too numerous for direct use in drawing general conclusions, the process of grouping is employed, to evolve from the cost-sheets brief reports, each of which presents to the interested manager a particular phase of the manufacturing operation.

## THE PERIODIC REPORTS

For the purpose of comparing present with past results of shop operation, and for checking the cost-accounts against the general ledger, the fiscal year must be divided into convenient periods. These must be arranged to terminate coincidentally with the pay periods. If pay periods are fifteen or thirty days, the thirty-day month is suitable. If the calendar month were used, the cost-accounts could not be checked against weekly pay rolls except by computing the wages for the odd fractions of the two pay-roll weeks in which the first and last days of the month fall. Some factory accountants make their periods include an integral number of weeks, making some four-week and some five-week months. But as unequal periods are not convenient for comparison, the best way is to divide the year into thirteen parts, each of four even weeks, and close the cost-records and the general accounts together at the end of each period.

Whatever system is chosen for dividing the year into periods, the charge sheets for uncompleted product-orders are totaled the day following the end of the period. The footings of all these charge sheets are then added together to give grand totals of material, labor, sundries, and burden on the uncompleted orders which make up the work in progress. The several factory-expense orders are also totaled, and their charge sheets are removed and filed away for reference. New expense sheets are then titled and put in the covers with the sheets belonging to the uncompleted orders, and the cost-books are ready for the next period. The Register of Completed Orders

## COST-KEEPING FOR MANUFACTURING PLANTS

is then totaled, and the periodic statement prepared in the cost-department to inform the accountant of the cost of material, labor, sundries, prime cost, burden, and gross cost, on each division of the factory product, and on the several expense orders for the period just closed; and of the amounts charged up to cover the administrative and selling expense.

The routine work of the accounting department is disorganized by demands for special statements at irregular intervals, and as a report or summary which is useful now will probably be as useful at other times to come, the system should provide for the regular compilation of useful statements. If this be arranged for, there will be few extra demands upon the accountant, and he will be able to plan his work in an orderly manner, and perform it with comparatively inexpensive help.

Of the various statements which are useful and desirable in a manufacturing establishment, some of the most important belong to the general accounts rather than to the cost-department. But as all of the regular reports are to be interrelated and harmonized, it will be convenient to describe them here without distinction.

The general accounts are the key to the whole situation. If profit is being secured, the organization may continue to provide its employees with the means of life, though perhaps not with extra comforts or luxuries. If the operation runs at a loss, all the daylight workrooms, shower baths, rest rooms, and libraries provided by the most ardent lover of mankind cannot feed the families

## THE PERIODIC REPORTS

of the workers, or prevent a financial crash when the working capital is exhausted. The management must watch the financial statements; and not only the profit-and-loss sheet, but all the accounts which lead up to it and go to contribute to or take away from the net earnings. As the accounting statements are essential and must be drawn up at regular intervals, it is advisable to make every manufacturing statement link in with the figures of the accounting department. The chief accountant is by disposition and training adapted to supervise the production of the works reports and lists. All such factory reports, by whomsoever developed or used, should be put in his charge, and so arranged and made up as to accord with the accounting scheme, and to come naturally from the records of the day's routine, without requiring special investigation or rearrangements, or interfering in any way with the regular work.

All statements are primarily intended for comparison with earlier sheets of the same kind, to demonstrate progress or deterioration. Comparison is facilitated by showing in parallel with the present totals those of last period and the same period last year. The total to date is useful in connection with many statements. In this way the changes are seen at a glance.

The first statement is that of the business-getting department, and sets forth the tangible results of the salesmen's work. The Statement of Sales (Fig. 34) is a summary of the orders obtained during the accounting period. Since the purpose of all periodic reports is to

## COST-KEEPING FOR MANUFACTURING PLANTS

bring out important facts with the least possible time and effort, this statement should be kept down to a single sheet of paper. Individual names and descriptions are omitted except in cases of special magnitude and interest. The orders are grouped into the several classes of factory product as they have been set apart; and again into groups to show the results of the work of each salesman or office. Each total is set against the corresponding total of the previous period or year.

### STATEMENT OF SALES—U. S. MFG. CO.—June, 1910

	Present	Last Month	Last Year	To Date
<i>Product:</i>				
Class A .....	\$5,200	\$4,000	\$3,370	\$25,000
Class B .....	2,219	1,800	1,780	7,400
Class N .....	6,205	5,600	3,100	35,050
Totals .....	\$13,624	\$11,400	\$8,250	\$67,450
<i>Salesmen:</i>				
Chicago Office .....	\$4,260	\$2,700	\$2,405	\$20,050
Jones .....	1,850	1,820	1,115	10,020
Sampson .....	2,100	3,180	1,400	10,460
Roberts .....	2,204	1,300	1,080	10,400
Mail Orders .....	3,210	2,400	2,250	16,520
Total .....	\$13,624	\$11,400	\$8,250	\$67,450

Fig. 34.

The statement showing the relation of income to expenditure is of great importance. This detail of business management seldom receives a thought by anyone in the works except the officer charged with the important duty of finding the money to keep the organization running. The workers have a vague and comfortable feeling that



## THE PERIODIC REPORTS

the money bag which brings the pay roll is filled from the company's barrel in the vault at the bank. The cost-clerks probably have a better conception of the facts, but are generally confident that the concern is prosperous if the outlay for material and productive labor keeps up to good-times figures, and factory expense remains normal. The sales department watches the apparent excess of selling prices over factory cost, and forgetting the bad debts, slow collections, and "reclamations" granted by the genial adjuster of differences, fancies that the margin of apparent profit insures big dividends at the end of the year. The financial head alone experiences the constant strain of getting the money in as fast as it goes out. Any of numerous possible causes may operate to delay payments for product which has been paid for by the works as material and wages, and then sold and delivered on account. Defects in product, delays in shipment, and misunderstandings cause failure to pay accounts promptly when due, and there is no way to force instant action by the debtors. The pay roll comes up each week for settlement in cash. Bills for material and supplies, while not as insistent, must be met without such unreasonable delay as will disturb the credit of the concern, or force creditors to increase quotations and shorten terms of payment on future purchases. The financial head must therefore watch sales, shipments, and accounts payable alike; and take steps to insure such deliveries as will secure payments from customers in time to meet the pay rolls and accounts

## COST-KEEPING FOR MANUFACTURING PLANTS

when due. The alternative is borrowing funds to carry the business over the crisis, or special efforts or price reductions to turn stock into prompt cash. Railroads and other large corporations, when their resources are strained to provide funds for present needs, sometimes pigeon-hole bills for months. The statement of income and expenditure shows the condition of the treasury, by setting forth the amount of cash on hand at the beginning of the period, the amounts received and the amounts paid out during the period, and the balance on hand at the end. Statements of this character are familiar to every skilled accountant, and being outside of the cost-keeping work, need not be illustrated here.

The General Statement already shown by Fig. 1 presents the value of the property of the concern, classified as cash, plant, equipment, material, work in progress, and accounts and bills receivable; and on the other side, the totals of accounts and bills payable. The account of "Product" appears on both sides. Its debit represents the cost of completed work, and its credit sets forth the selling price charged for the product delivered. The excess or deficiency of the total amount charged as burden, as compared with the actual expenditure, also appears in this Statement. These amounts being totaled as debits and credits, will differ by an amount representing the value of the business as a property belonging to stockholders, mortgagees, or proprietors by whatever claim. This difference will be represented by the Capital accounts, or the face value of stocks and bonds.

*But why should  
"Product" appear on  
both sides? This is  
an awkward  
way of treating  
it.*

WORKS REPORT OF U. S. MFG. CO. FOR SECOND PERIOD, 1909.

January 30 to February 27.

	Material.	Labor.	Sundries.	Burdens.	Admin.	Sell.	Gross.
Balances Forward.....							
Material.....	\$28,002.41	\$190.00		+ \$220.45	+ \$48.27	+ \$200.45	
Finished Parts.....	422.01	217.50		195.18			
Work in Progress.....	5,682.24	3,725.48	\$212.52	2,610.80			
Expenditures.....	6,422.30	3,621.47	325.48				
Shop Salaries.....		645.00					
Totals to Date.....	\$40,528.96	\$8,399.45	\$538.00				
Product A.....	\$2,200.44	\$1,136.50	\$34.00	\$842.40	\$526.67	\$421.33	\$5,161.34
Product B.....	3,920.40	1,357.28	177.03	1,038.90	811.70	649.36	7,954.67
Product N.....	807.35	568.40	41.02	114.70	191.43	153.15	1,876.05
Improvements.....	40.75	25.90	4.02	18.20			
F. P.....	460.10	280.27					
Work in Progress.....	5,428.40	3,081.05	210.79				
Total Product.....	\$12,857.44	\$6,449.40	\$466.83	\$2,014.20	\$1,529.80	\$1,223.84	\$14,992.06
Shop Expense.....	\$310.50	\$921.00	\$71.14	\$40.20			
Shop Salaries.....		645.00					
Total Burden.....	\$310.50	\$1,566.00	\$71.14	\$1,987.84			
General Expenses.....					\$1,641.02		
Selling Expenses.....						\$1,327.27	
Forward Balances.....						+ 200.45	
Total Factory Operation.....	\$13,167.94	\$8,015.40	\$538.00				
Forward Balances.....							
Material.....	\$27,361.02	\$384.05					
Finished Parts.....	460.10	280.27					
Work in Progress.....	5,428.40	3,281.05	\$210.79	\$2,404.10			

FIG. 35.

## COST-KEEPING FOR MANUFACTURING PLANTS

The works report (Fig. 35) is the one which sets forth the figures obtained in the cost-department. It shows the manner in which the amount expended for factory operation has been distributed. The values of "Material" on hand; "Finished Parts," (expressed as material, labor, sundries and burden); and "Work in Progress," (expressed as material, labor, and sundries,) are followed by the "Expenditures" for sundries, material, and labor during the period, and the four columns are totaled to give the amounts to be accounted for by the factory. A double line is drawn across the sheet at this point. Below the line appear the figures showing the disposition made of the amounts above. First is the cost of work billed, divided into material, labor, sundries, and burden, one line across the sheet being given to each class of product, including plant improvements and finished-part orders. Following, comes the value of "Work in Progress" or uncompleted, this time the value at the end of the period, to be contrasted with the amounts above which showed the value at the beginning of the period. These columns are totaled to show the value of the "Total Product." A line is now drawn across the sheet to separate this from the "nonproductive" expenditure or burden, which follows. As only a single line is available in this condensed works report, the amounts of the several expense orders are set forth on a separate sheet, and footed to give general totals of material, labor, sundries, and burden where otherwise "productive" tools and men were diverted to shop upkeep, and the totals alone are carried to the

## THE PERIODIC REPORTS

works report. The expense totals are next added to the totals of product cost above to give the total cost of factory operation for the period, which appears on the line entitled "Total Factory Operation."

Next come the derived figures, which show important facts. In the column "Burden," \$2,014.20 has been charged on the cost-sheets for product, and \$40.20 on cost-sheets for expense work, a total of \$2,054.40 distributed; against which appears \$1,987.84, the total factory expense or "burden" made up of the five expense items standing in the two lines above. The difference is \$66.56 overdistributed, which is to be added to the balance of \$220.45 brought forward from last month, making a total of \$287.01 to go forward to next month's report. Note here that the true amount of overdistributed burden is this amount of \$287.01, increased by the burden which has been charged on any increase in "Work in Progress" during the period. At the beginning of the period burden on work in progress was \$2,610.80. At the end of the period, however, instead of an increase, there is a smaller value represented in "Work in Progress," and the burden charged against it (see the last line of report) is shown by the cost-sheets to be only \$2,404.10. The difference is \$206.70, and this subtracted from \$287.01 leaves a balance of \$80.31 only. The amount overdistributed at the beginning of the period has therefore nearly disappeared because of the falling off in distributed or charged burden. This may be caused by a decrease in output, which could be ascertained by com-

## COST-KEEPING FOR MANUFACTURING PLANTS

paring this works report with the last; or it may be due to the manufacture of a larger proportion of product on the smaller machines, leaving the larger machines to run shorter hours and fail to earn their "keep."

There should be a sufficient surplus "overdistributed" to cover the allowance for depreciation, which has already been determined in the chapter on "The Computation of Burden Rates." If preferred, the depreciation allowance may be added on the sheet of factory-expense accounts from which the total burden was taken; in which case the burden total will be increased, and there will be no necessity for a large margin of excess of distributed burden over actual burden.

The Administrative and Selling Expenses are given in the two last columns. The first shows a deficit, for there is only \$1,529.80 distributed against factory product, with \$48.27 forward from last month, a total of \$1,578.07, against which stands an actual expenditure of \$1,641.02, a difference of \$62.95 against next month. Selling expense shows a small overdistributed balance of \$97.02. These small differences do not warrant any change in burden rate at present, as the inevitable fluctuations in the monthly expenditures will cause greater differences from month to month.

The remaining lines carry forward the balances for next month's report. After the burden balances, the total of material and labor in the line "Factory Operation" is deducted from the total on hand above, and the balance is set down as "Material" on hand. Under this

## THE PERIODIC REPORTS

is repeated the totals of "Finished Parts" completed and of "Work in Progress," as these two items of product have not left the factory, and are therefore to be carried forward.

If contract work outside the factory forms any great part of the operation, there should be a special report devoted to this department. Single orders form in some factories very large items of the whole outlay, and if so, should be reported specially instead of being left concealed with the general "Work in Progress" totals. If there is such a special report, the total appears on the Works Report as a separate line, "Unfinished Contracts," immediately following "Work in Progress" in the list of Factory Product items.

The Unfinished Contract report is based on detailed cost-sheets kept for each contract separately. These are systematized by first preparing a list of standard subdivisions to be followed both in estimating on new work and in cost-keeping after the order is secured. For instance, in the sale of machinery involving delivery, erection, and operation the items may be:

- Gross Cost of Machinery,
- Boxing, handling, freight, and unloading,
- Foundations,
- Erecting Expense,
- Testing Expense,
- Special Extras.

Each contract job is done on a factory order, and its cost is carried on a regular labor-sheet form. The col-

## COST-KEEPING FOR MANUFACTURING PLANTS

umns are headed for the standard subdivisions, as shown by Fig. 36, and the estimated amounts are filled in on the first line at the top of the sheet, in red ink, for comparison with the cost-entries as they are written up. At the close of each period a line is drawn across, and the totals are carried forward under the line. The Unfinished Contract Report (Fig. 37) is made up by entering the numbers and names of the contracts in the first column; the amount expended on each to the end of previous month in the next; the amount of the month just ended in the next; the estimated amount required to complete the work in the fourth; the total estimated cost, the sum of the last two items, in the fifth; and last, the selling price, added by the accountant, after the sheet is received from the cost-department. The amount required to complete is estimated roughly and generously, subdivision by subdivision, by the foreman or superintendent in charge of outside work. On work just commenced, the whole amount of the estimate, less the percentage of profit allowed in making up the quotation, is assumed to be the probable cost. As each subdivision nears completion, the estimate of work required to complete is altered to accord with present conditions. The element of uncertainty thus gradually disappears as the contract runs on toward completion. However, in every manufacturing business, unexpected items may crop up at the last moment and diminish apparently certain profits. "Contingent Liabilities" should therefore be allowed for by a fixed rule or percentage, set, if possible, by experience.





## COST-KEEPING FOR MANUFACTURING PLANTS

It should be noted that the works report deals with costs only, and does not show selling prices. Profit and loss statements are of a private nature, and should not be prepared in the cost-department. The figures from the works report serve for the cost side of the statement of profits. Opposite the total-cost figures for the several classes of product are placed the corresponding totals of the prices at which the classes were sold. Comparison of the footings of these two columns shows the profits on completed work. Nothing can be done to show the profit or loss likely to occur on work in progress, which in some factories and seasons may form the greater part of the factory work during the period. Under normal conditions the value of work uncompleted varies little from day to day, as shipments keep pace with new orders. If this condition is disturbed, it is possible to approximate the profit on any excess of uncompleted work over the normal by reckoning the same percentage of gain on the uncompleted work as on that completed. But for factory work that involves large amounts on single orders, as where heavy machinery must be delivered, set up, fitted out and operated to the purchaser's satisfaction by the factory force, the item of contingent liabilities is too large to permit the arbitrary assumption of any profit on uncompleted work, and in all such cases there should be a special periodic report of uncompleted contracts, showing the cost to date in comparison with the amounts allowed in the original estimates.

# Unfinished Contracts March 1910.

Date	To Last Mo.	This Mo.	To Date	To Complete	Est. Total	Sale Price
Quincy 20 March Eng 1321		756.45	256-50	160000	145000	500000
Quincy 20 March 1211		575	611-00	60	70000	110500
W. C. Co. 10-11-10 1476	1100.00	550	110550	30	17500	135000
Johnson 5 March 11 1441						
Wallingburg 20x 30x 15 1560	721560	325000	1057000	200	1673000	1450000

90 x 11 inches

FIG. 37.—UNFINISHED CONTRACT REPORT.

## COST-KEEPING FOR MANUFACTURING PLANTS

Every one of the periodic reports should be scrutinized by the general manager, compared with the reports of previous periods, and all differences noted, and if not due to obvious causes, investigated carefully. As already mentioned, comparison is facilitated by having important items, such as the report of factory burden, written off in parallel columns against the figures of "last month" and "same month last year." The whole field of the factory work is thus laid before the management, and the conclusions drawn from the reports are the basis for plans for improvement in details suggested by the existing conditions.

## CHAPTER XVI

### THE PROPER USE OF THE COST-SYSTEM

WHILE the subject of cost-keeping has received the attention of many competent accountants, and its principles have become reduced almost to an exact science, the results secured from systems installed under apparently promising conditions prove in many cases disappointing. This is not always due to defects in the methods employed. Careless clerical work or willful blundering by the shop force are responsible for the failure of many a promising cost-system, however carefully developed by the skilled accountant to meet the particular requirements of the factory. In fact, there is not uncommonly a strange indifference on the part of the very men who paid for the introduction of the system, so that the records go unheeded until financial disaster comes upon the business.

To make the best use of cost-records, two principles must be clearly grasped. The cost-records must be minutely and accurately detailed, so that discrepancies due to carelessness or inefficiency may be traced down and the responsibility placed where it should fall. They must also be summarized in such a manner that unimportant details will not obscure the major facts. Thus the over-

## COST-KEEPING FOR MANUFACTURING PLANTS

worked foreman is assisted in keeping track of the efficiency of his employees, the busy manager is advised of the increasing or decreasing cost of similar pieces of work, and the sanguine salesman may take warning by any failure of the factory to make profits on work at prices he has fixed. As the factory orders are completed, the cost-summary sheets accumulate rapidly. They should be rigidly kept in order, and protected by loose-leaf covers so as to prevent damage from the frequent handling they will receive. The alphabetical index by name of customer, already provided by filing the card copy of each shop order, and supplemented by the numerical file in the cost department, will in many cases be enough; but if similar work is wanted for comparison from time to time, tabs may be pasted to the index cards, showing by their position the class of work. For instance, all orders for punches may be designated by projecting tabs at the extreme left of the cards; orders for drills, by tabs in the position next to the left, and so on to as many as ten different locations. Colored tabs can be used to give still further distinction between classes. It is often desirable to provide a cross index for finding previous orders for the different kinds of product by names or sizes. This is a separate index, with cards so arranged and provided with proper guides that all factory orders for each kind of product may be found together, and those for similar manufactured articles of different sizes readily located when wanted for reference.

## PROPER USE OF THE COST-SYSTEM

The routine work of the cost-system must be kept up promptly and accurately. The expert accountant is fully aware that his books are of the greatest value as a source of accurate information for the administrative head. He should instruct his cost-clerks that their records are for general use by all persons employed by the factory, to the extent that each is enabled by the duties of his position to make use of them, but no further. Accountants may be expected to be temperamentally suited to the exercise of administrative functions, and to act in all their dealings with others on courteous, generous, and agreeable though authoritative lines. The cost-clerk will not generally be a skilled accountant, but should be none the less intelligent, agreeable, and courteous, with a knowledge of human nature, so that in his continual dealings with the working force he may represent his chief, the factory accountant, as the chief would himself act under the same circumstances. He must be careful to avoid friction with foremen and workers, by showing them by his manner and actions that he is doing his best to make the performance of their duties in connection with the system as easy as possible. The cost-clerk will often be called upon for specially quick completion of a cost-record to allow of quick invoicing. He must furnish when desired abstracts or transpositions from several cost-sheets, to give a means of approximating the cost of proposed new work. The foremen will often ask for individual job tickets by which the efficiency of different workmen and the time and wages cost of pre-

## COST-KEEPING FOR MANUFACTURING PLANTS

vious shop operations may be ascertained. In all his dealings with fellow-employees the cost clerk must stand upon his rights with regard to his routine duties in keeping his record accurate and his system in order, and at the same time must manage to accommodate those who properly make demands upon his services. It is evident that the routine work of the cost-system requires a sufficient force to carry it on easily under ordinary conditions, with a little margin of time and effort in reserve for emergencies. Rush work can then be provided for without allowing the cost-records to fall behind, or requiring too much overtime, which induces carelessness and slighting of work. A new cost-department should always be started with a very liberal force of clerks, and the best of these selected for the permanent force, while the inefficient men are dropped as the routine becomes familiar and goes more rapidly as experience is gained in the work.

With a properly summarized cost-sheet, it is possible to set the invoice price for all work done on open order and without a previous estimate, from the record of actual cost, so that billing at a loss is prevented. Within a few minutes after a factory order is completed, the management should know whether the work has cost so much as to make the transaction unprofitable. While selling prices cannot be always made from costs, costs must be made to keep within selling prices, or the days of the factory organization are numbered. Correct burden rates are of the greatest importance in this connection.



## PROPER USE OF THE COST-SYSTEM

There is little hope for the success of a management which cannot see the difference between the margin which almost always exists between the direct cost and the selling price, which margin is sometimes wrongly called the "gross profit," and the real net profit realized after all expenses have been covered. By invariably carrying the addition for burden opposite the figures of direct cost, the apparent ample percentage of safety which is often supposed to cover any degree of extravagance in factory expense would be seen in many cases to afford no profit at all.

For keeping up the efficiency of the shop, the system of recording the time of each job by a separate job ticket is excellent, as it affords the means of ascertaining the speed record for any single operation whenever desired. With the job tickets properly indexed by guide cards, and arranged by groups covering each class of factory process, and classified under further subdivisions as the tickets accumulate in quantities, many valuable comparisons may be made. The efficiency of any particular workman may be investigated by comparing his times on jobs which he is known to have handled with the times of other men on similar work. The cost of doing work on one machine may be compared with the cost of making the same piece on other machines; or the cost of making a piece last year may be contrasted against the cost of making it this year. By referring to the group totals, the cost of any important portion, such as the valve gear of one engine, may be compared with the cost of that on

## COST-KEEPING FOR MANUFACTURING PLANTS

a previous order. Changes of this nature may be due to improvement in design, or improvement in machine operation, or better attention to work in assembling, and the true cause may be ascertained by the study of the original job tickets. Comparison may be made between the weights of material used on different jobs, which in some lines of work is a matter over which the workmen themselves exercise some measure of control. As these comparisons may be overlooked or slighted by the man most interested, the accountant should see that they are made, and that important facts disclosed are brought to the attention of the management. If the factory product consists of large units, such as expensive machines, a book may be provided for each interested party, in which the summary of each successive order is entered upon completion, directly under the summary of the last similar job, and the unit price per pound, horse power or other suitable unit of comparison may be also set down.

Important as the cost-system is for showing what has been done, its value is still greater for showing what should be done hereafter. Nine tenths of the estimating done in quoting on new work is based on guesses; whereas, with a well-indexed cost-system covering the records of two or three years, the sales department could quickly obtain the cost of a prospective order by simply making up an estimate from details of previous similar work. Thus, if there is wanted a price for a steam plant, consisting of three boilers, one vertical cross-compound engine, and one vertical simple engine of smaller size, the

Cost-System is  
used for obtaining  
an estimate on  
new work

## PROPER USE OF THE COST-SYSTEM

cost might be closely approximated from past work, as follows: The cost of the boilers might be obtained from the record of two boilers of slightly smaller size, making a suitable increase to suit the dimensions of the new boilers. The cost of the double engine might be made up from the cost of a previous simple engine, less the cost of the fly wheel, doubled to provide for the two essential parts of the cross-compound type, with the cost of the necessary fly wheel taken from another order, and an addition made to cover the extra cost of the larger cylinder required for the low-pressure side. Similarly, the other details might be made up, and a summary made up which would afford a greater approach to accuracy than any rough guess based on the total and unclassified lump cost of a previous but different plant.

The effect on the selling price of a change in the market value of a raw material can be easily provided for by making the necessary addition for the increased cost of the number of pounds of this class of material which previous summaries show to be required. The price of a machine or device may be compared with that of a similar device on a pound basis, dividing the total cost by the total weight of material, which will often be found a very useful check. Cost estimates made in this way from actual cost-summaries and group totals give better results than the laborious method in use by some factories of working out the expected cost of every minute operation by having some man with experience form a mental guess as to the probable expense of lifting the

## COST-KEEPING FOR MANUFACTURING PLANTS

piece from the floor, fastening it to the machine, taking one cut, and so on; and the estimate will be ready much sooner and at less expense.

The indexing of the cost-system has hitherto not received the attention it deserves. It is the key to the whole value of the cost-accounting department, and should be kept up most strictly, as records will be hopelessly lost without it. High-priced accountants are often employed to establish systems, and from notions of mistaken economy dismissed as soon as the mere routine is understood by the force employed for the purpose. Where such notions control, the leading men who are supposed to take up the responsibility thereafter are usually so overworked as to be quite unable to supervise the new system in addition to their previous duties. The condition is similar to that which often exists in shops which have provided a supply of high-speed steel, and failed to see that it was properly used. The workmen soon go back to their former tools, or use the new steel like the old, forgetting that it should be treated differently and made to do far more work. It is useless to purchase expensive steel for tools to be used on old and weak machines, or placed in the hands of ignorant and prejudiced workmen. It is equally foolish to install an expensive cost-system, to pay competent men for carrying on the work, and then to pile up unindexed records safely in a fireproof vault, while the custom of guessing at the cost of work gradually resumes its way.

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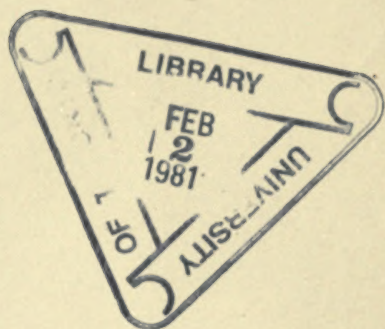
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